PERMANENT FILE

LITERATURE

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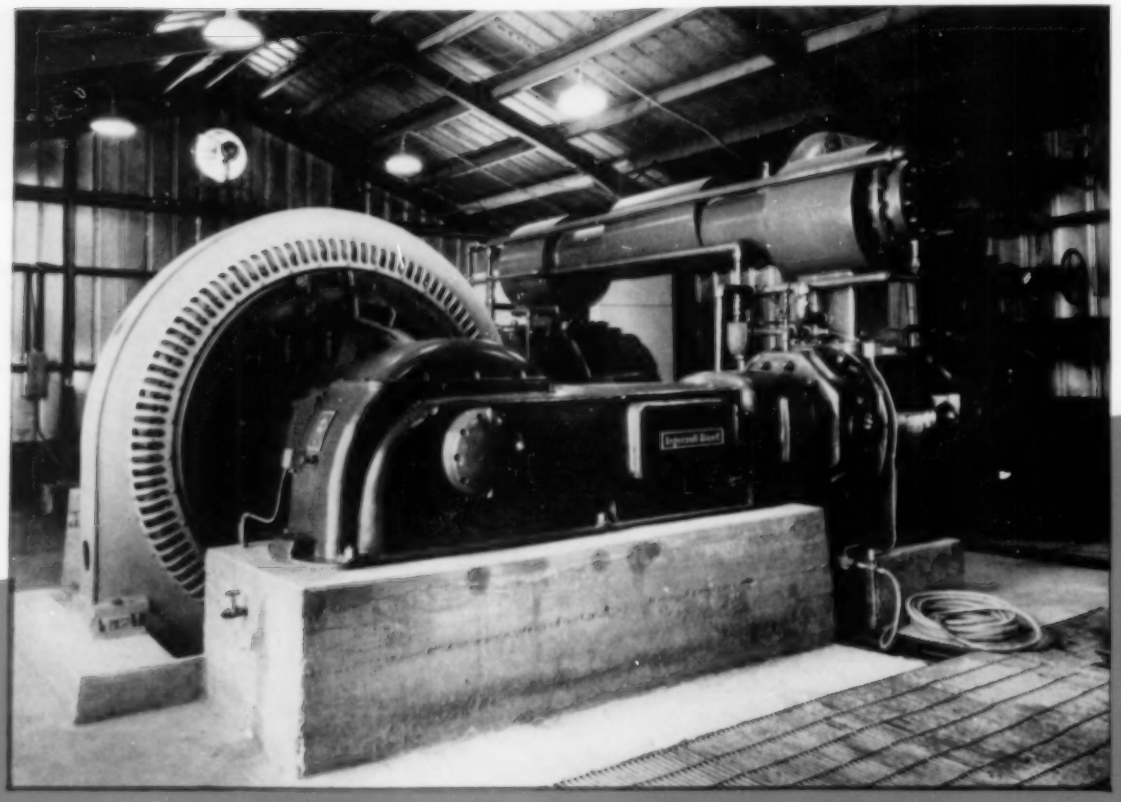
X-1850 2M 10-54

Compressed Air Magazine

ASSEMBLING PIPE FOR STREAM SPAN

Welders tack on section of 24-inch gas main to go under Susquehanna

VOLUME 59 • NUMBER 10 NEW YORK • LONDON



NO RUST NO DEPOSITS in air compressor systems

WHEN you lubricate your air compressors with *Texaco Regal Oil R&O*, you can be sure that systems and lines will stay clean — free from rust and harmful deposits. Piston rings will stay free for maximum efficiency, and valves will seat properly, function perfectly.

Texaco Regal Oil R&O is made from selected base stocks that are highly refined and then *further improved* by the addition of effective rust and oxidation inhibitors and special processing to prevent foaming.

Whatever the size or type of compressor, whatever the number of stages or pressure involved, whatever the operating conditions, there is a *Texaco Regal Oil R&O* exactly right to assure highest operating efficiency.

A Texaco Lubrication Engineer will gladly help you select the proper one for your compressors. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils R&O

FOR ALL AIR COMPRESSORS AND OPERATING CONDITIONS

TUNE IN . . . TEXACO STAR THEATER starring JIMMY DURANTE or DONALD O'CONNOR on television . . . Saturday nights, NBC.

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ABSORPTION FILTERS PROVIDE

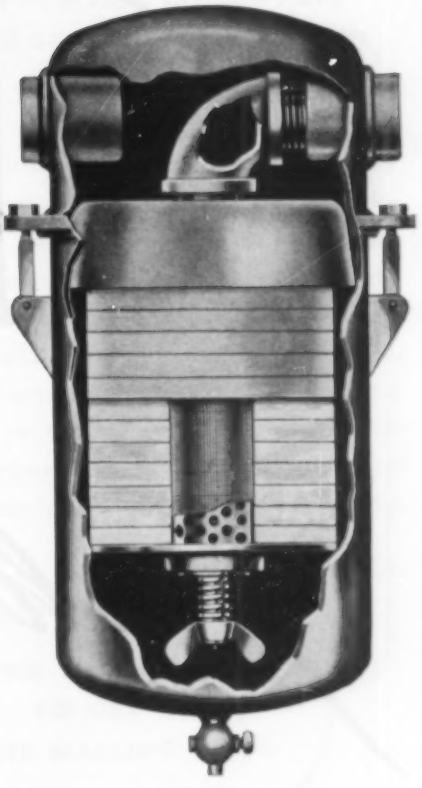
SUPER FILTRATION!

—REMOVE LAST TRACES OF OIL AND MOISTURE FROM COMPRESSED AIR LINES

The model AAPH Absorption Type Filter has proven itself to be the real answer to the elimination of costly service interruptions in utility and industrial power plants. Many manufacturing processes and certain compressed air operated equipment require the removal of condensed oil and water vapors *completely* from the compressed air. In thousands of installations all over the country, Staynew Absorption Filters remove the last traces of oil and moisture and prevent failure of combustion and other pneumatic controls . . . keep maintenance time and cost at a minimum.

For Complete Information, Write Today For Bulletin B-1A

Representatives in Principal Cities



MODEL AAPH
Absorption Filter

DOLLINGER REG. PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS

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ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

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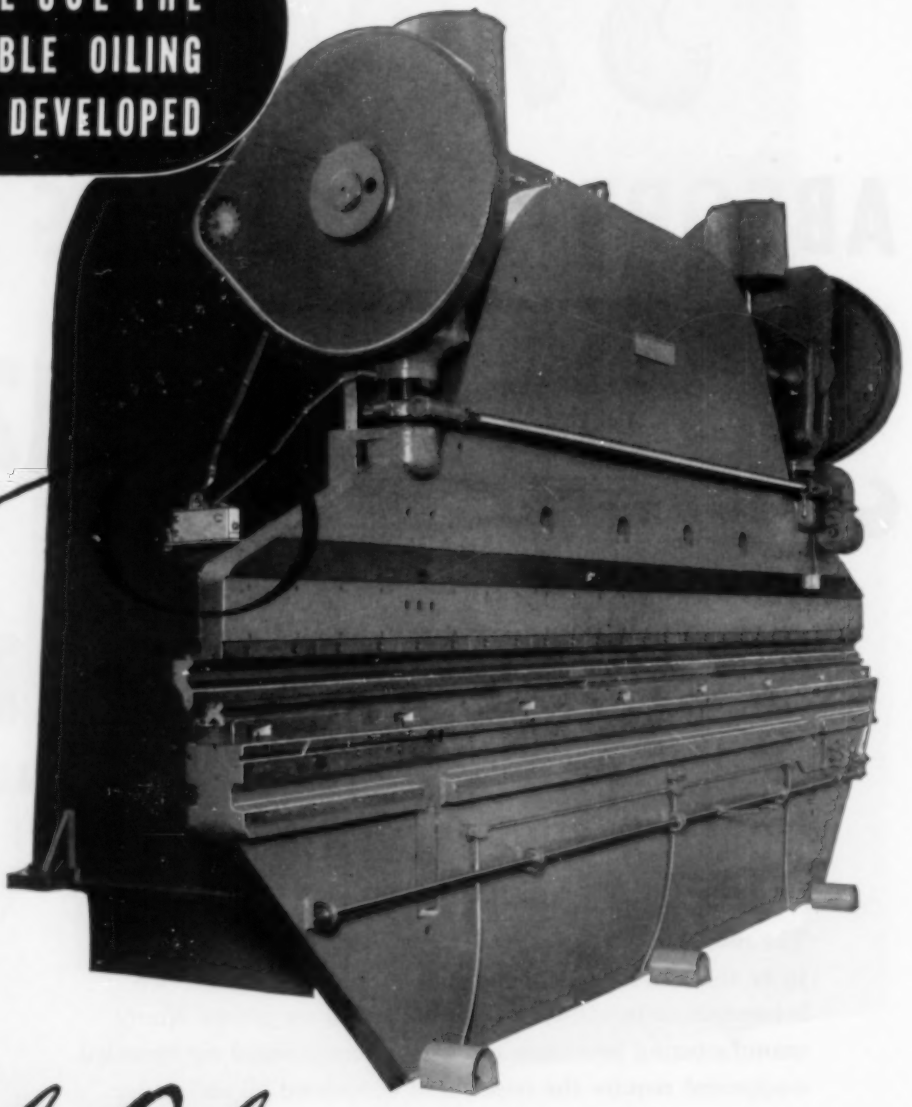
MACHINES OF GREAT PERFORMANCE USE THE MOST DEPENDABLE OILING SYSTEM EVER DEVELOPED



Illustrated is Madison-Kipp Lubricator Model FD installed as original equipment on a ⅜" by 20' Cincinnati Press Brake, manufactured by the Cincinnati Shaper Co., Cincinnati, Ohio.

MADISON-KIPP *fresh Oil*

. . . by the measured drop, from a Madison-Kipp Lubricator is the most dependable method of lubrication ever developed. It is applied as original equipment on America's finest machine tools, work engines and compressors. You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy where oil under pressure fed drop by drop can be installed.

MADISON-KIPP CORPORATION

202 Waubesa Street, Madison 10, Wis., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

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- **New engineering information on neoprene, Du Pont's chemical rubber**
- **Detailed on-the-job reports showing how neoprene cuts replacement costs**
- **Case histories on how new products are developed . . . old ones improved . . . with neoprene**

FREE! Valuable information for you in every issue of the Neoprene Notebook. Timely, illustrated articles on the properties and performance of neoprene show how others have increased production . . . reduced operating costs . . . with this durable chemical rubber. Perhaps the Neoprene Notebook can help *you* solve a tough production problem, or suggest a way to develop or improve a product. Get your free subscription today by sending the coupon below!

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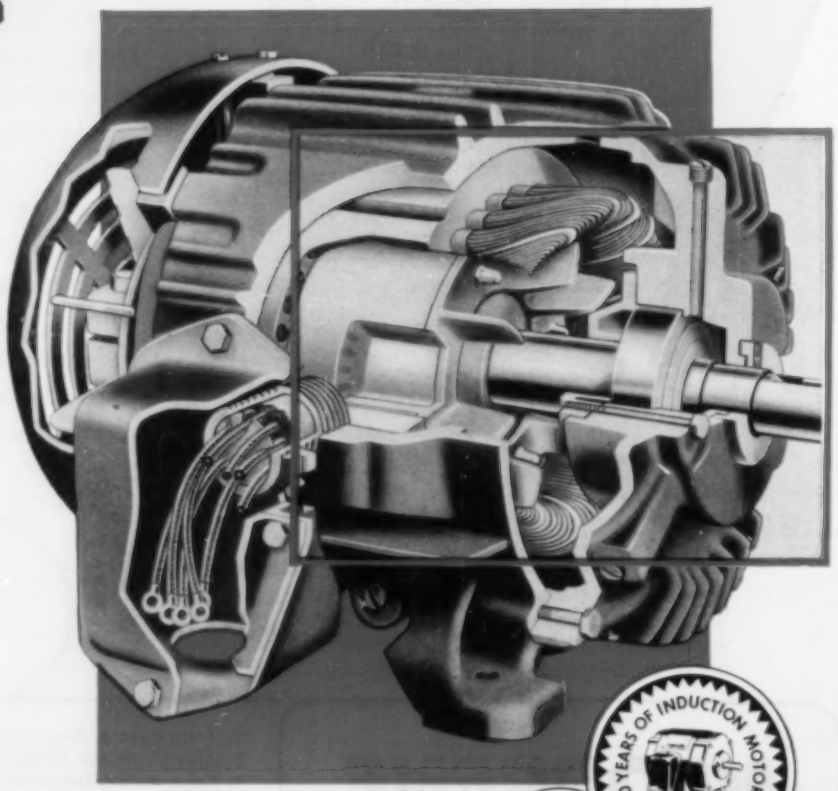
It takes Six Bolts -

not just four

to give full bearing protection for greater motor performance



THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.

50 YEARS OF INDUCTION MOTORS
ALLIS-CHALMERS-NORWOOD WKS.

Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-4444

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Make Schrader controls your partners in production

Watch the results when you harness compressed air with **Schrader Air Control Equipment!**

On many machines, Schrader Control Sets will actually *double your production* by replacing tedious, time-wasting manual operations with swift, safe, sure *movement by air*. In other locations, Schrader Valves, Cylinders and other Air Line Accessories lift . . . lower . . . pull . . . push . . . clamp . . . clean off—do so many things so easily and quickly that you'll find it hard to believe you did without them before.

Hard to believe? Just look quickly around your plant—keeping in mind where *air power* can do the job better. Then let us help you develop your ideas into neat, efficient air line hook-ups that will pay for themselves over and over again the first year. For specific information, write—or, if you prefer, fill out the coupon below.

Schrader®

LEADERS IN AIR CONTROL SINCE 1844

A. Schrader's Son
Division of Scovill Manufacturing Company, Incorporated
478 Vanderbilt Avenue, Brooklyn 38, N. Y., Dept. W-8

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Name _____ Title _____

Company _____

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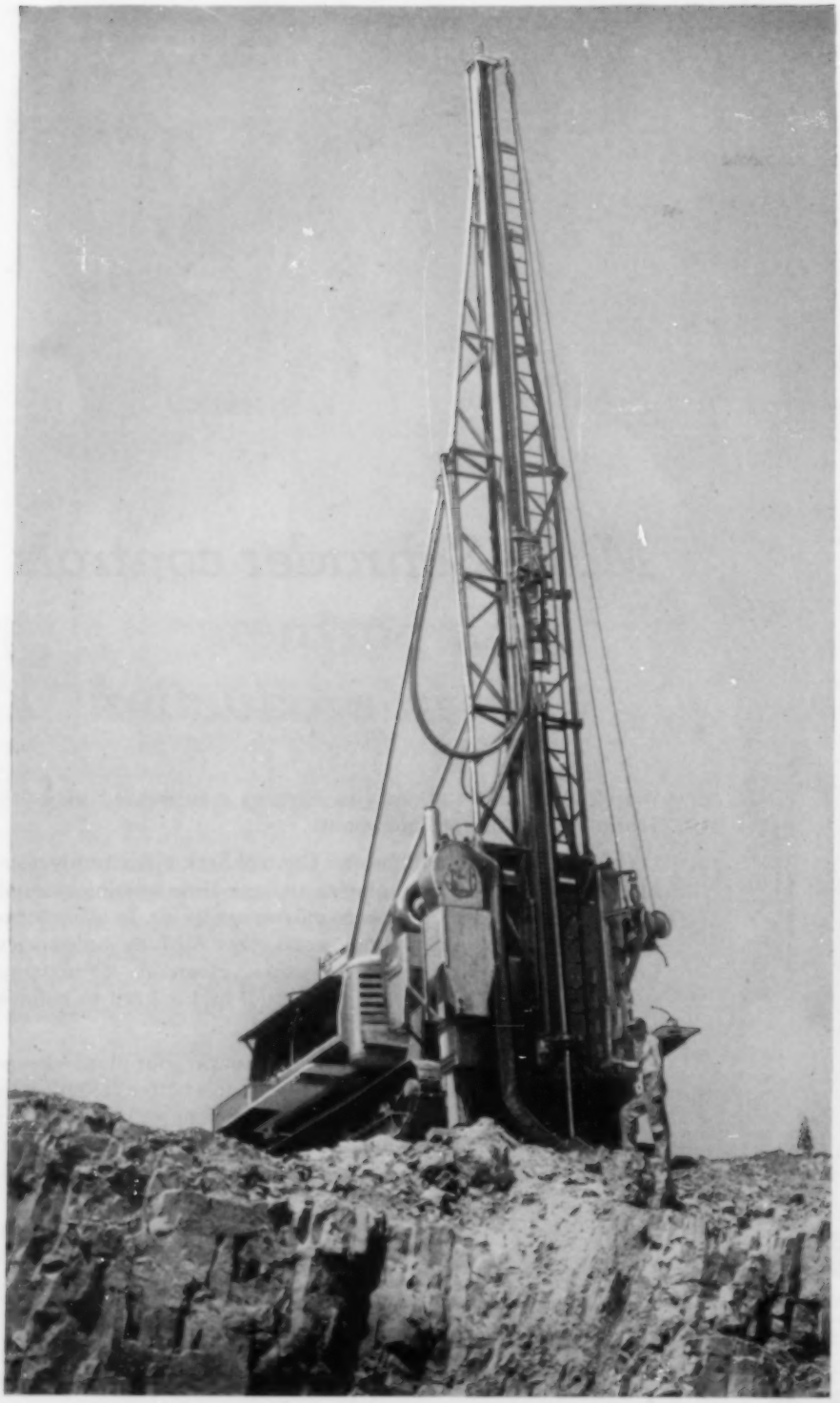
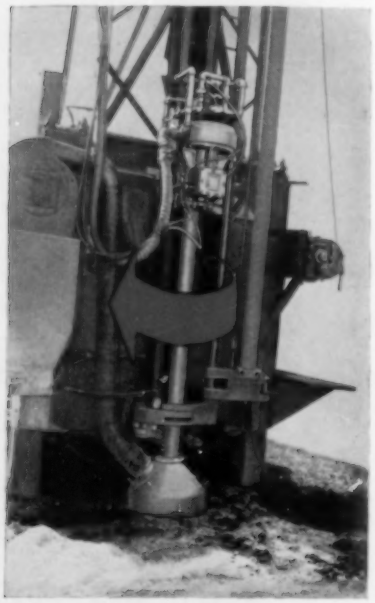
NOW — with

ROTARY



Ingersoll-Rand Quarrymaster, with percussion-type drill, sinking primary blast holes on a large construction project. Note how close to the face the holes can be drilled.



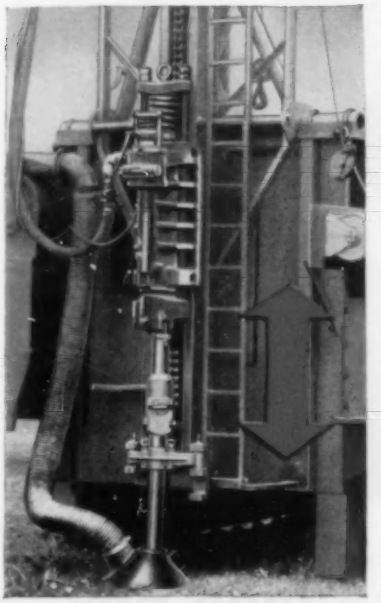
Power for rotary drilling is supplied through powerful twin multivane reversible I-R air motors. Drills 20 to 150 feet per hour depending on the rock. Hole cleaning, as in the percussion drill, is automatic and done by air.

Uses rotary type bits up to 9" in diameter —These are the same familiar oil field type bits used the world over.

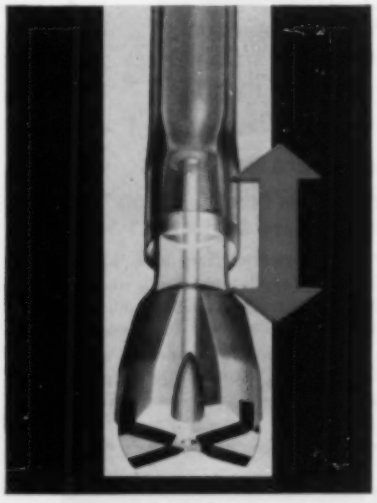
ROCK DRILLS • COMPRESSORS • AIR TOOLS • TURBO BLOWERS

One Machine . . .

OR PERCUSSION DRILLING



Heart of the percussion machine is this powerful air-operated piston drill that strikes 200 blows per minute. Drilling speeds range from 10 to 50 feet per hour. Hole cleaning is done by air and is entirely automatic.



Carset bit life is 700 to 1600 feet in granite —up to 14,000 feet in soft, less abrasive formations. Bits up to 6½" diameter.

NEW UNIVERSAL QUARRYMASTER

permits fastest drilling in any type of ground!

Here is the first *universal drill*—a completely self-contained, self-powered and self-propelled machine with interchangeable rotary and percussion drilling units. It enables you to use whichever drilling method is best suited to the type of ground being worked.

When equipped with the powerful *piston drill*, the Quarrymaster can drill any type of material from the hardest rock to consolidated top soils and hard pans. When a *rotary* drilling head is applied it is ideal for the softer or less abrasive rocks and overburdens.

In open pit mining whether your cap rock is hard and the ore soft, or vice versa, the Quarrymaster will drill either one at the fastest rate and the cheapest way possible. If you are a drilling contractor or quarry operator, the dual principle gives you the right drill for any rock conditions, anywhere.

Conversion from one type to the other takes but a few hours and consists of simply removing one drill from the tower and replacing it with the other.

The Ingersoll-Rand Quarrymaster is reducing primary blast-hole drilling costs all over the world. Now, with the new Universal Design, it offers still greater opportunities for saving time and expense on *any* deep hole job!

Call your Ingersoll-Rand branch office today for complete information on the new Quarrymaster. Or write for your copy of Bulletin No. 4153.

Ingersoll-Rand

11 Broadway, New York 4, N. Y.

5-73

• CONDENSERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

Here it is—

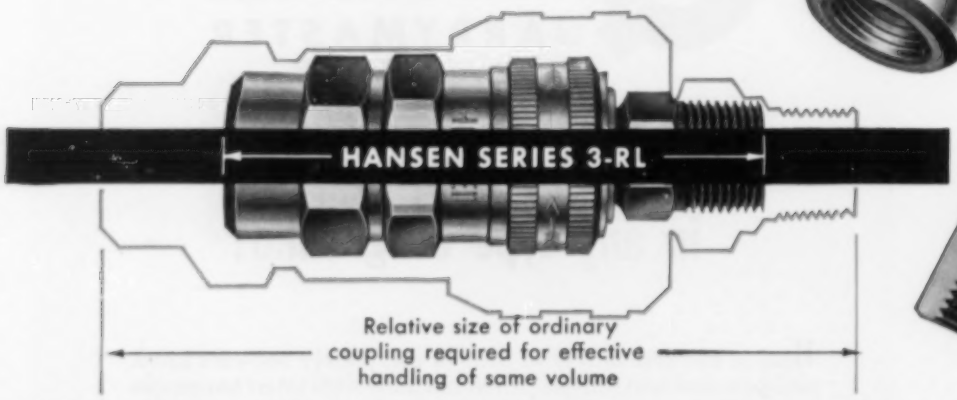
THE NEW

HANSEN

SERIES 3-RL

QUICK-CONNECTIVE

RING-LOCK COUPLING

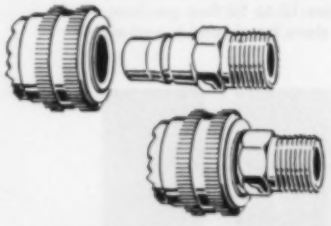


Effectively handles far more volume than any coupling of equal dimensions

Tough, compact, smaller, the new Hansen Series 3-RL Coupling will handle any job in your shop using ¾″ to ⅛″ connections—from the air line to the air tool. No longer is there any need for various sizes of couplings at different points in your hook-up. The Hansen Series 3-RL, with completely interchangeable sockets and plugs does it all—makes it easy to keep stock of parts in balance—holds inventories to a minimum.

Carefully designed, the Hansen Series 3-RL combines maximum flow with compact construction. Sockets are brass with steel sleeves—plugs are steel. Sockets for use with small hand-operated air tools are available in aluminum.

Write for Descriptive Literature



POSITIVE LOCKING

Ring Lock Provides Practically 360° Metal to Metal Contact

• Equipped with automatic sleeve lock, the Hansen Series 3-RL Coupling is quickly and positively connected merely by pushing plug into socket. To disconnect, just turn the sleeve. Locking ring in socket is forced into groove in plug, provides practically 360° metal to metal contact, reduces wear, and insures tight fit.

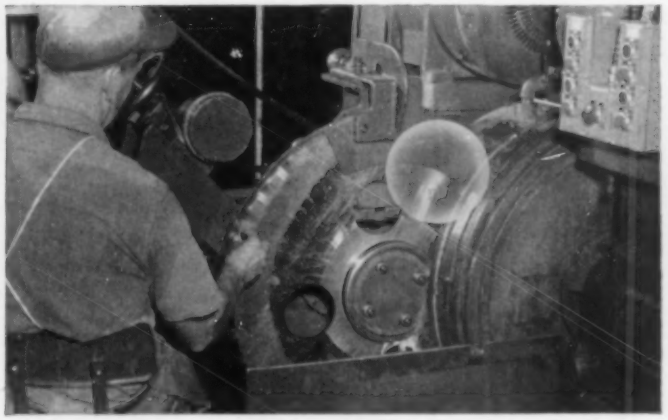
THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

Norton covers the entire disc grinding range

Norton discs are engineered for every type of grinding, on all materials, all machines — to bring you the profit-boosting

"TOUCH of GOLD"



What Norton discs have done for others is good evidence of what they can do for you. Check these reports, typical of many from present users:

"Best discs ever received. Produced over 6,000,000 piston rings — 100% more than our former discs, with 50% less dressing. Results duplicated in subsequent shipments."

"Outlasted and outperformed all other discs — gave 366,975 pieces without burn."

"Averaged 21,500 pieces, a new high for this job."

"Outproduced previous discs 2 to 1."

"High above competition for output and grinding quality."

"Gave 20% longer service life."

Whatever your disc grinding requirements may be, Norton will meet them exactly — with discs engineered for coolest cutting action and longest, most productive service life. Norton discs of ALUNDUM* and CRYSTOLON* abrasives are made in all grit sizes, all grinding grades, five types of bonds and all types of mountings. They are precision-built, by exclusive Norton processing, to assure closest uniformity of grinding action from disc to disc and lot to lot. Which means that each time you re-order to the same specifications, you'll get the same top performance — next week, next month or next year.

See Your Norton Distributor

for practical aid in selecting the Norton discs that will add the money-saving "Touch of Gold" to every disc grinding job you do. Ask him for the new booklet, "Disc Grinding". Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed under "Grinding Wheels" in your classified phone directory. *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Massachusetts. W-1585

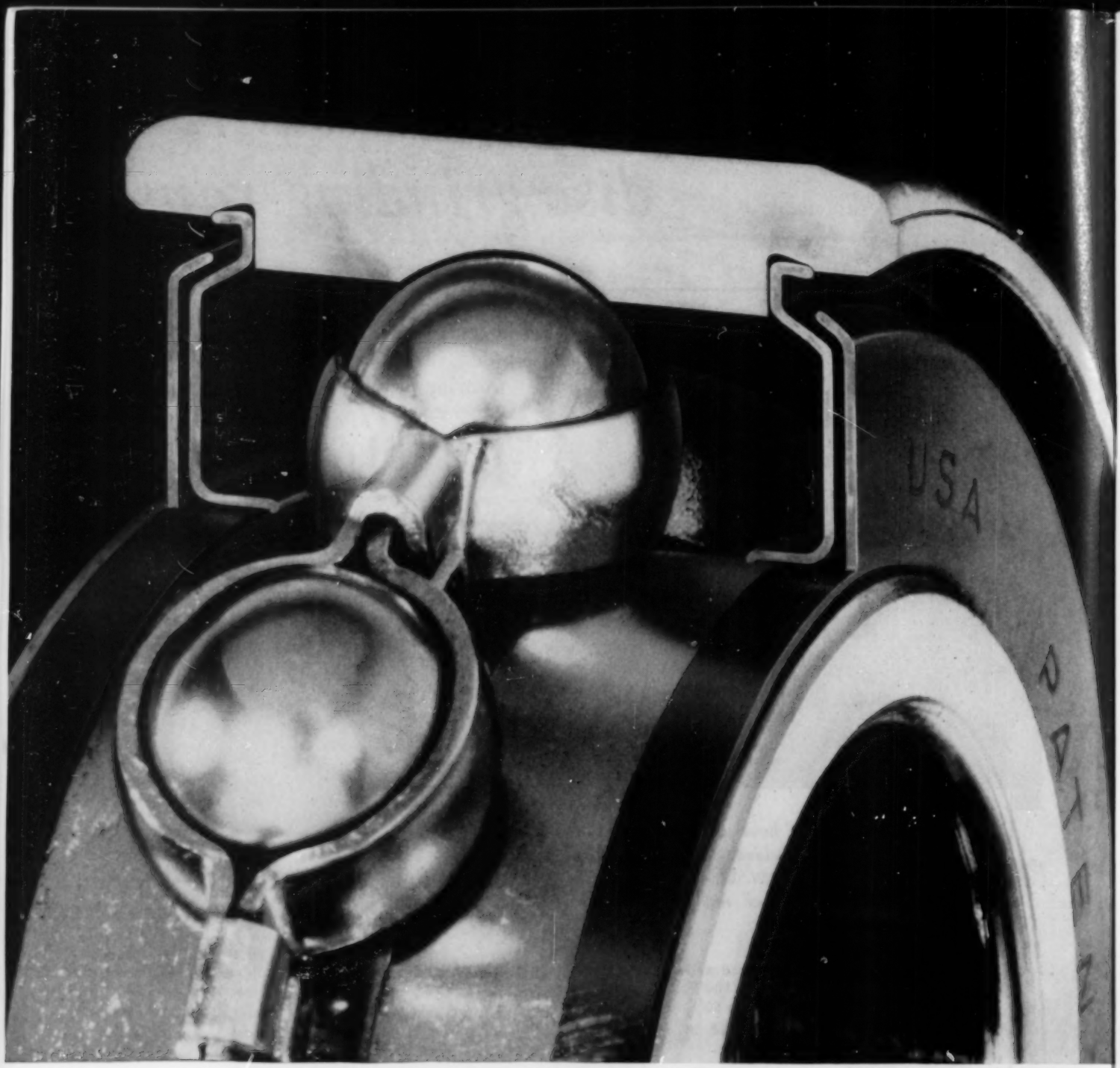
Making better products . . . to make other products better

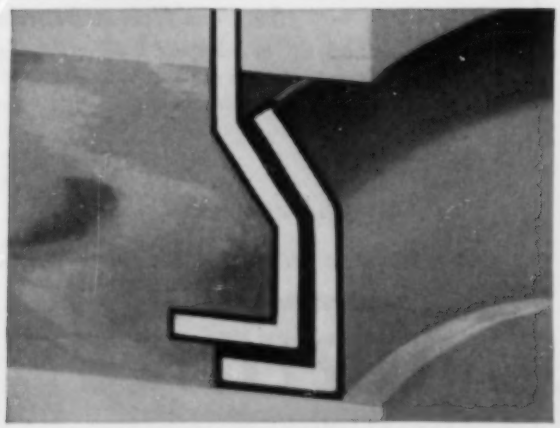
NORTON

and its BEHR-MANNING division

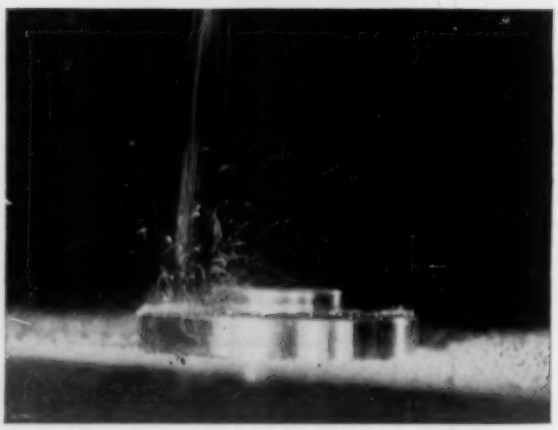
NORTON: Abrasives • Grinding Wheels • Grinding Machines • Refractories
BEHR-MANNING: Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries





POSITIVE LABYRINTH. A joint is only as effective as its seal. Countless research studies have shown that the labyrinth is one of the most effective ways to seal a joint where at least one member rotates. Further sealing action is achieved by the film of grease that fills the minute clearance between the two seals.



FLINGER ACTION. One of the most important functions of the outer rotating seal is to throw off any foreign element that tries to enter the bearing. This flinger action is achieved by the centrifugal force set up by the rotating seal. Elements attacking the bearing are repelled.

Exclusive 4-way seal guards new Life-Line A bearing

Here's why you can count on reliable Life-Line A motor performance

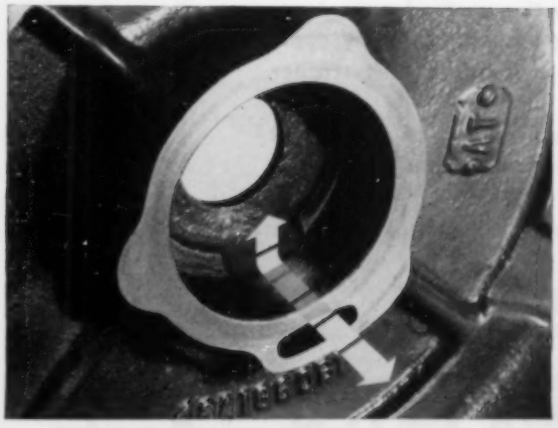
There are three factors that affect motor bearing life: (1) type of lubricant, (2) amount of lubricant, and (3) presence of contaminants. The one *sure* way to control all three is to use a bearing that is pre-lubricated at the bearing manufacturer's plant and then SEALED.

Many of the original Life-Line® pre-lubricated bearings installed in 1937 have been running ever since and are still like new. Now, Westinghouse offers another important step ahead... a pre-lubricated motor bearing that has *four* seals... two on each side. Here's real bearing protection. Grease is sealed in. Contaminants are sealed out. No on-the-job greasing is required—EVER.

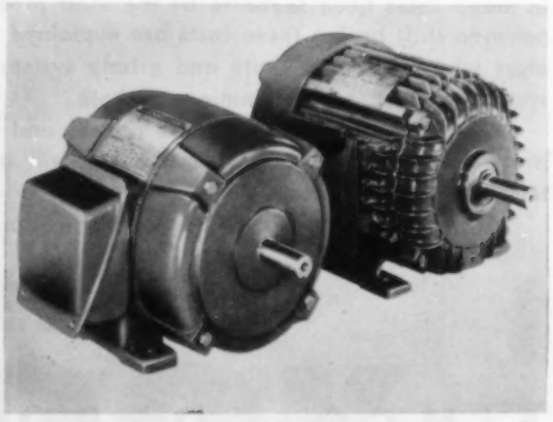
This new concept in motor bearings is one of the many improvements Westinghouse has incorporated into the complete, balanced design system that makes the Life-Line "A" motor your best buy. Get all the facts from your local Westinghouse sales engineer. Or write for Booklet B-6154-A. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21849

YOU CAN BE SURE... IF IT'S

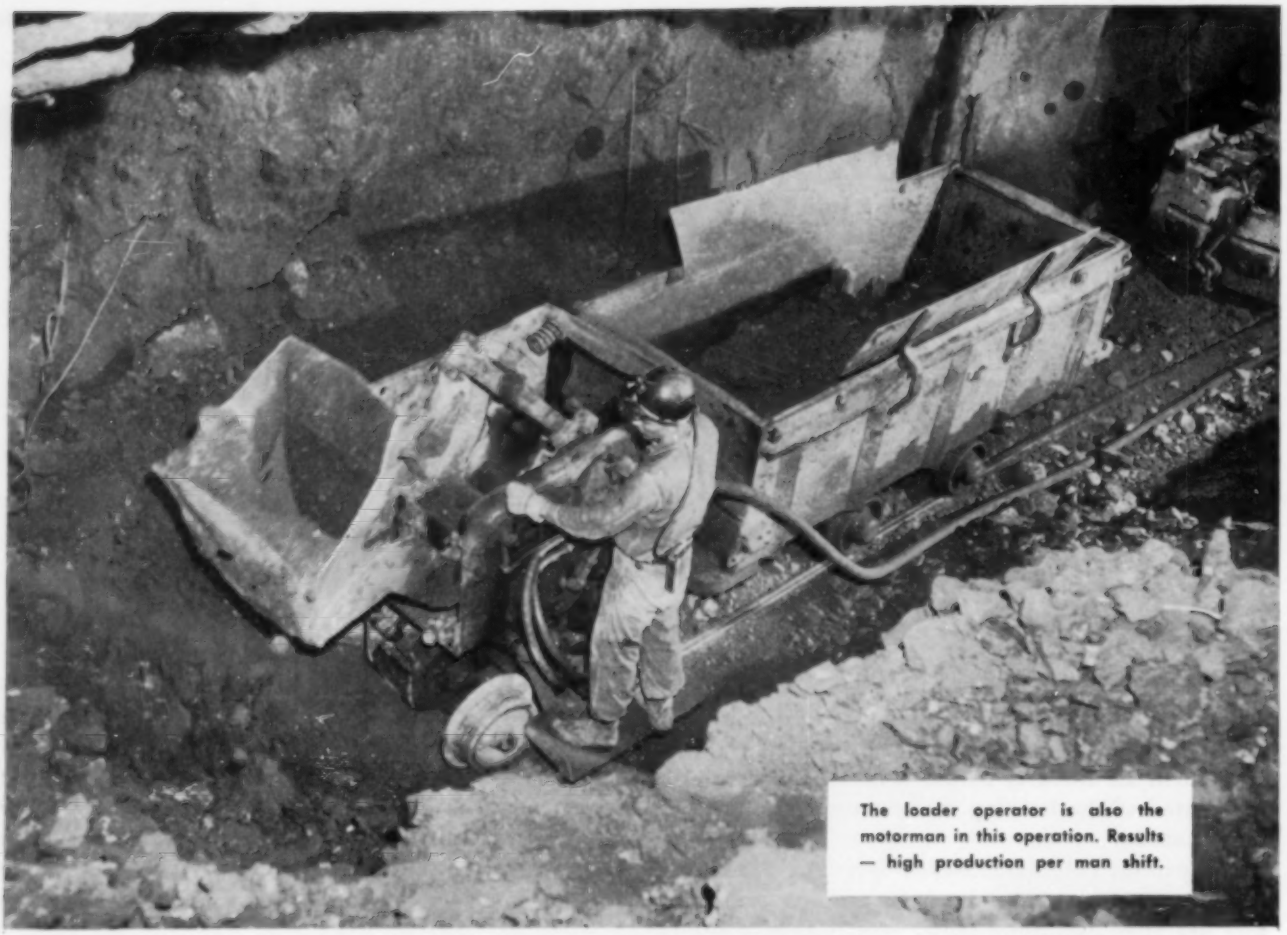
Westinghouse



AIR BY-PASS. Totally-enclosed motors "breathe" as the internal air expands and contracts with change in temperature. Ordinary motors "breathe" along the shaft and through the bearings. Life-Line provides an air by-pass around the bearings to keep out contaminating air.



The performance of any motor is dependent on the performance of each component of that motor. It takes balanced design. That's why every component in the new Life-Line "A" motor has been redesigned and integrated with the whole. The result is a motor with superior performance and consistent dependability.



The loader operator is also the motorman in this operation. Results — high production per man shift.

LOW COST PRODUCTION

Tonnage loaded into cars for transporting to the surface is the tonnage measured for mine production.

Dependable loading equipment and efficient loading methods are more responsible than any other factor in keeping production up.

Eimco loaders in conjunction with drawpoint mining systems, have in many cases been found to be the most productive method on a tons-per-man shift basis. These facts are explained in recent papers by operators who have used chute and grizzly systems and scram drift scraper systems as well as combinations of both.

Write for your copy of these papers and information on drawpoint production loading with Eimcos. These will be your guides to greater tonnages at lower costs.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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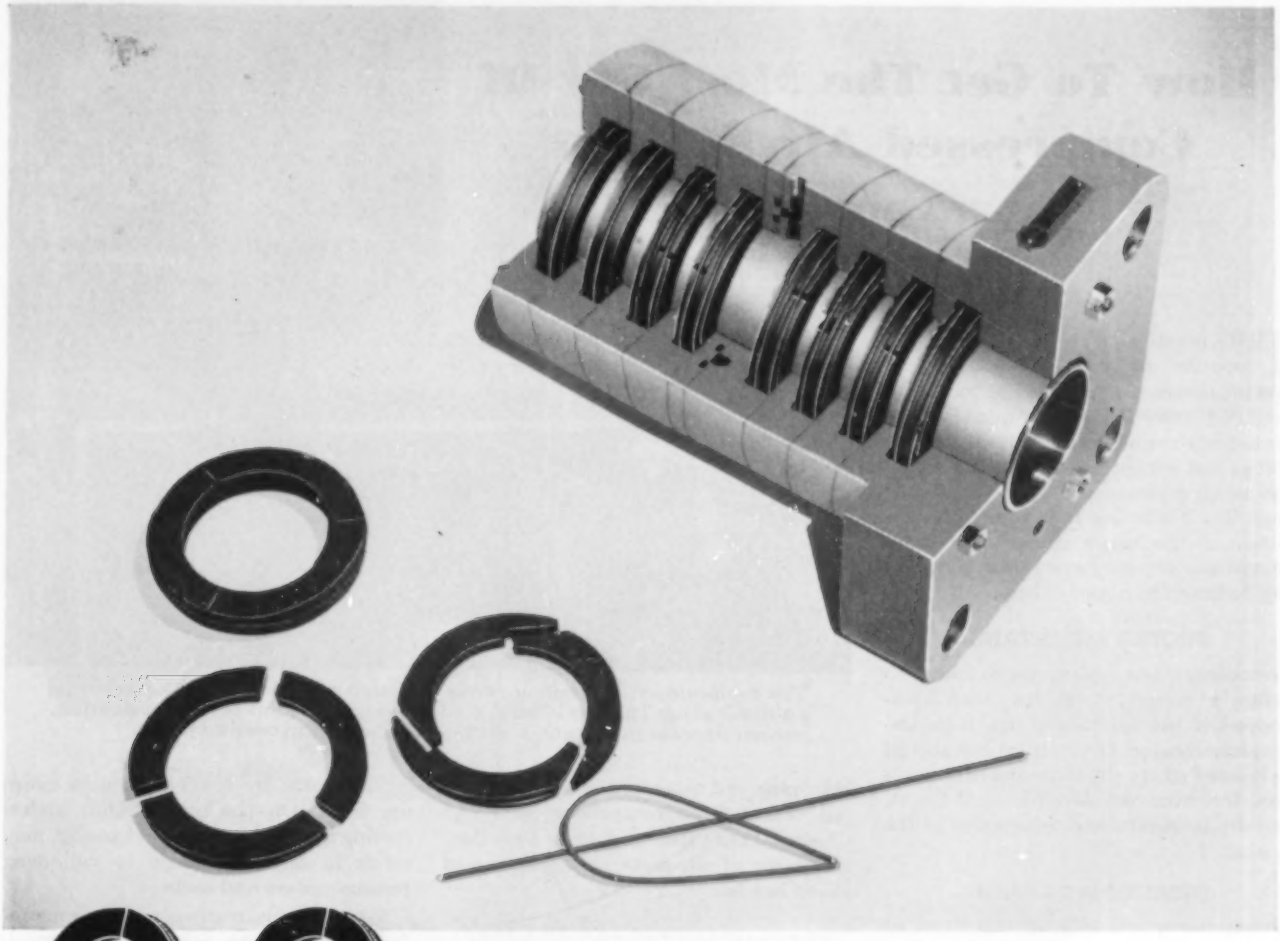
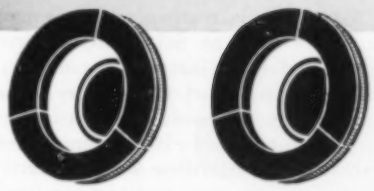




Look to COOK

for Better Non-Lubricated CARBON PACKING

COOK carbon packing rings are made of a special carbon graphite material that automatically assures you *high resistance to wear, chemical inertness and excellent heat conductivity.*

COOK Rings *in any case* make for a better seal — but when placed in a *Cook case* assure you the perfectly engineered carbon packing. If you have sealing requirements for non-lubricated compressors, write today for a sample carbon ring, plus literature on Cook's complete line of packing materials. Address C. Lee Cook Manufacturing Co., 920 South Eighth Street, Louisville 3, Ky.

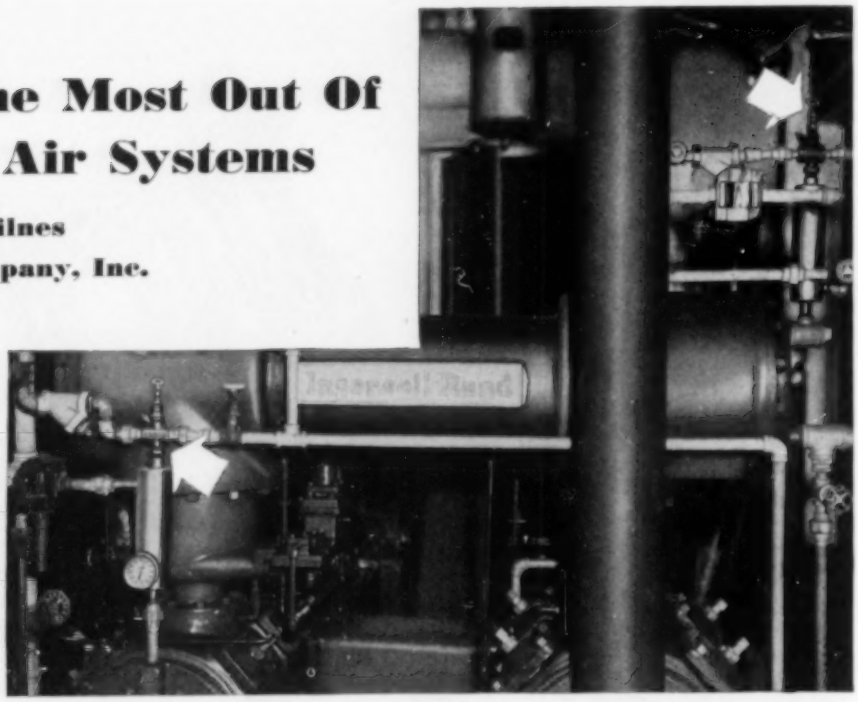
C. LEE COOK MANUFACTURING CO.

Sealing Pressures Since 1888

How To Get The Most Out Of Compressed Air Systems

A. Milnes

Sarco Company, Inc.



The replacement of hand controls by Sarco automatic cooling controls on this 2-stage Ingersoll-Rand compressor resulted in better lubrication, less condensate in air, and a considerable saving in cooling water.

THE practical place to measure the capacity of your compressed air system is where it counts the most—at your compressed air tools. From the time air is first drawn into the cylinder, many things can happen which will effectively reduce air pressure and limit compressor capacity. Following is a concise explanation of the major causes of reduced compressor capacity and the steps which can be taken to remedy them.

PROPER AIR INTAKE

Your compressor system can be fouled up before a pound of air has been compressed if the air intake has been improperly located. The air intake should be located where the atmosphere is clean, cool, free from corrosive chemical fumes, and dry to minimize condensation in the system.

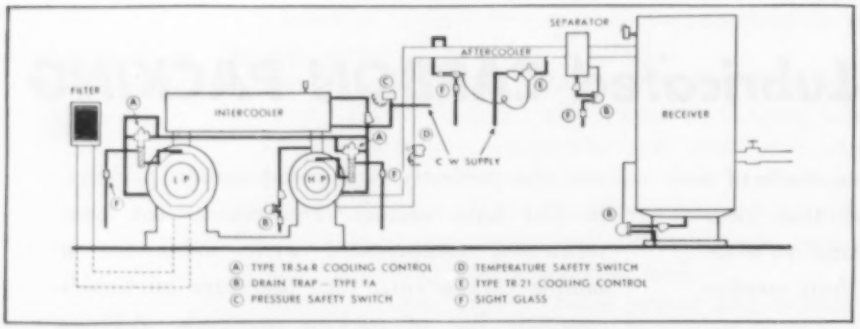
INTAKE PIPE DESIGN

A compressor can only operate at rated capacity if its air supply is unimpeded. Twisting, undersized pipes and dirty filters can effectively reduce air pressure at the compressor inlet. For example, a pressure loss of 2 psi due to friction in the intake pipe and filter will reduce the output of a 125 psi compressor by 7.5%. Check intake pipes and make sure they are short, of adequate size, and free of sharp bends.

AUTOMATIC COOLING CONTROL

One of the major causes of inefficient compressed air operation is unbalanced cooling. For example, overcooling wastes water, causes deterioration of compressor lubricant by condensation in cylinder head. On the other hand, undercooling reduces compressor capacity, may result in serious damage to cylinders, pistons, valves and seats.

To offset this, many compressor manufacturers such as Schramm, Ingersoll-Rand, and others install Sarco automatic cooling controls at the factory. These controls are self-modulating, insure optimum cooling effect with minimum water consumption regardless of load variation, changes in pressure and temperature of water supply.

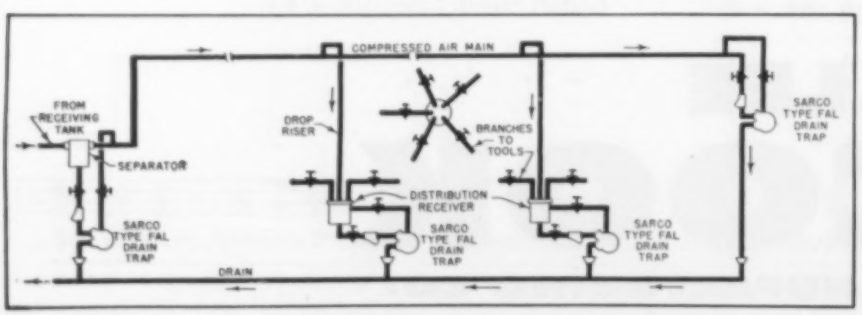


Sarco cooling controls are installed to regulate the water supply to cylinder jackets so that jacket discharge temperature is between 100-115° F.

CONDENSATE REMOVAL

If condensation is not kept to a minimum serious damage can result to tools, paint surfaces, molds, etc. Other results of excessive condensation in the system are water hammer and freezing of mains, receivers and tool exhausts.

To prevent this, well-designed compressed air systems usually have Sarco drain traps installed at the aftercooler, on separators, at receivers, and on low points in the lines to remove water as quickly as it collects.



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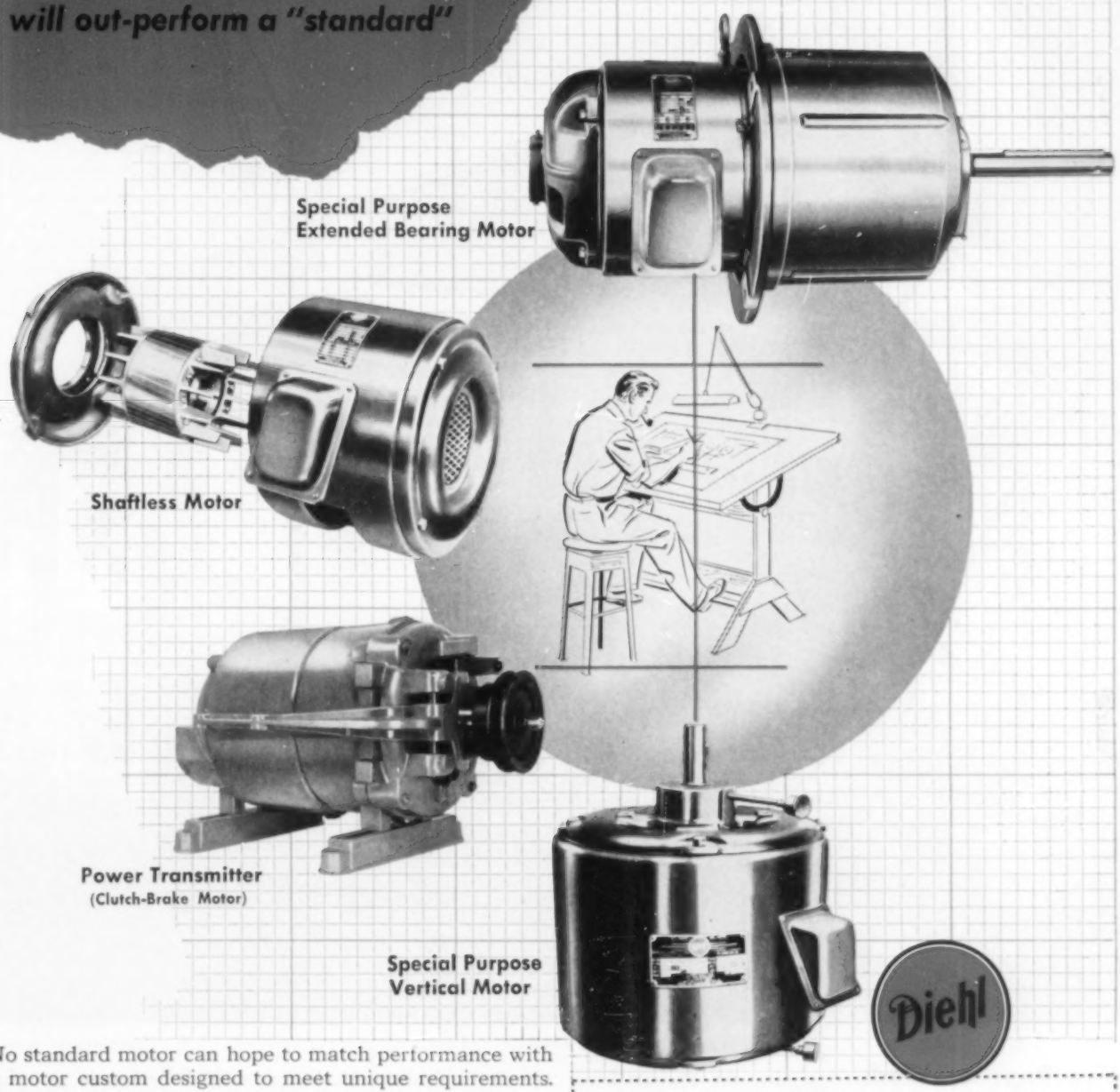

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ON THE COVER

TRANSMISSION arteries for natural gas and petroleum grow about 40 feet at a time. The 265-mile line that will deliver gas from Oakford storage field near Pittsburgh, Pa., to Texas Eastern Transmission Corporation's main-line compressor station at Lambertville, N.J., is a short one by today's standards, yet it is made up of nearly 35,000 lengths of pipe. Each has to be incorporated by welding, and the joints must hold fast against hundreds of pounds of internal pressure when gas starts moving through.

Our cover picture was taken on the east bank of the Susquehanna River, 10 miles upstream from Harrisburg, Pa., where Pentzien, Inc. (see article starting on Page 274) was burying a 24-inch and a 16-inch line in trenches excavated in the stream bed. As the concrete weighted sections were pulled into the river, new lengths were added on the bank. The piece of 24-inch pipe shown as it is being connected weighed close to 16,000 pounds, yet was held in exact position by the side-boom tractor until it could be securely tacked by the welders. The welding machines in the left background are mounted on steel sleds to permit dragging them over any sort of terrain by tractor power.

IN THIS ISSUE

THE concluding installment of the article on *Protecting Men and Machines from Dust* deals with filters as such and explains the different methods of separation for which they are designed. Page 280.

•

MORE than 2000 applications have been found for a product almost unknown a few years ago. It is adaptable molded nylon and is described in an article beginning on Page 285.

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THE natural wonders of one of the world's most scenic attractions is to be preserved by construction work now being done at Niagara Falls. Page 288.

CORRECTION

CHIEF Joseph Dam was erroneously referred to as St. Joseph's Dam in the heading (Page 254) of an article on the project in the September issue.

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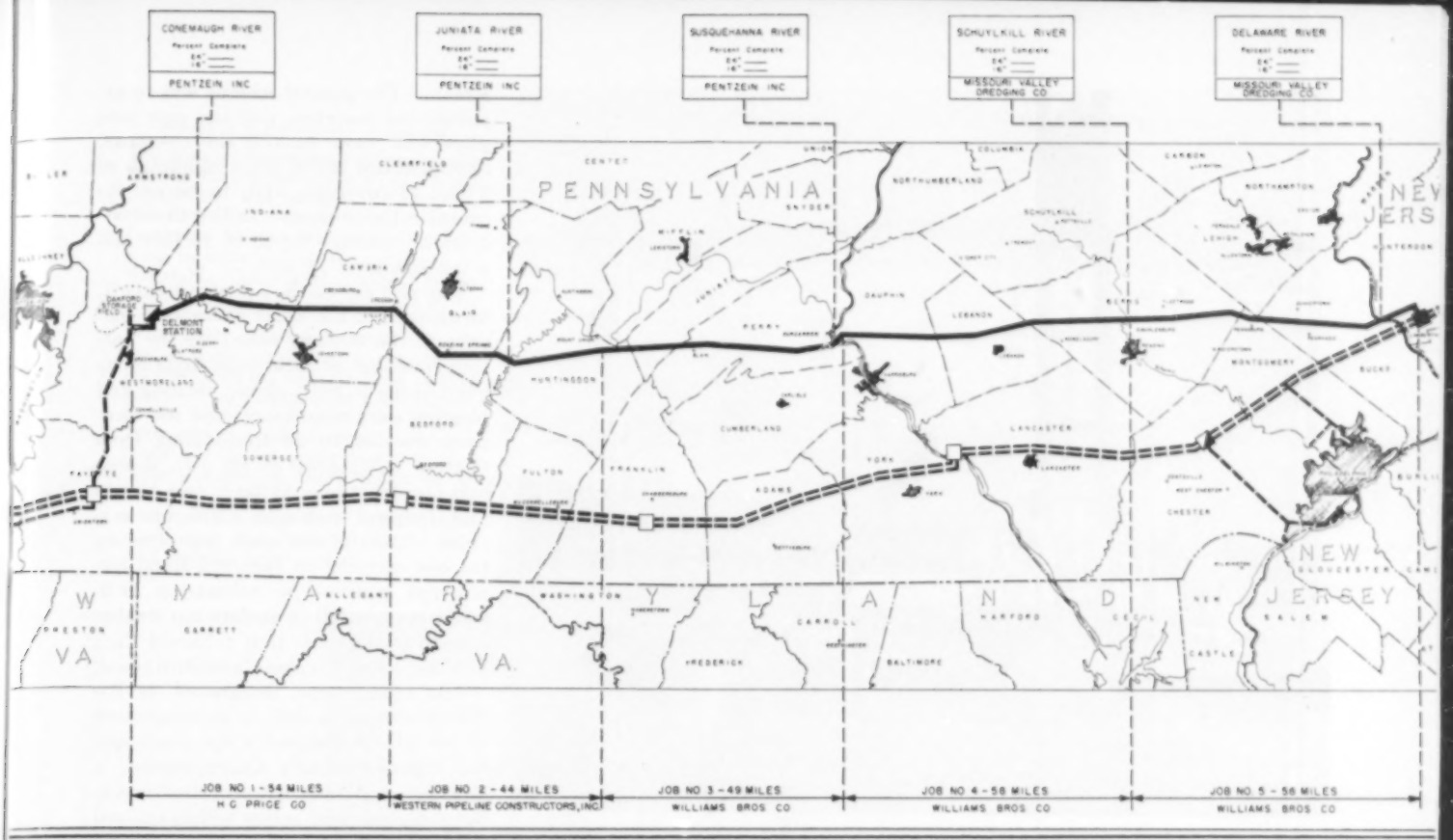
VIEWS FROM OPPOSITE SIDES OF THE RIVER

At the top is a view from the east shore when excavating was nearing completion. In the foreground is the 16-inch line which had been pulled into its trench to about mid-river. Parallel with it and to the right is the trench for the 24-inch pipe. Floating pontoons just visible were holding it off the bottom while it was being pulled out from the near shore. Note the partly submerged central roadway that was made by dumping some of the material from the trenches into the space between them. The bottom picture was taken from the west shore on the same day. The dragline at the left is excavating blasted material from the trench for the 24-inch pipe. As the machine traveled along it built up its own road behind it. Then it removed the spoil in front of it to a depth of 10 feet, piling it in the windrow, left.



ROUTE OF THE LINE

The upper solid line shows the course of the 265-mile 24-inch link between Oakford storage field, close to Pittsburgh, and Texas Eastern's main line (double broken line) near Lambertville, N.J. The lengths of the five sections in which the new line was built and the companies that did the work are indicated at the bottom. The five major river crossings and their contractors are listed in the boxes at the top. The Susquehanna job, with which this article is chiefly concerned is near the center. The broken line at the left shows the pipe line that delivers gas to the Oakford reservoir.

DRILL BOAT ON THE SUSQUEHANNA

How Pentzien, Inc., Laid Two Gas Lines Across Wide Pennsylvania River

C. H. Vivian

TO FACILITATE the construction of long, large-diameter natural-gas or petroleum transmission lines they are normally built in several sections, each of which is contracted separately. This practice yields the economies of competitive bidding and insures speedy completion. The sectional contracts include crossings of the smaller streams along the route, but not of the larger ones. The latter jobs are handled by specialists who work only on the water stretches.

Rivers are, of course, as temperamental as people. Some of them rampage periodically and establish new channels here and there without warning. It is therefore necessary to study their habits and behavior for a number of years past to make sure that crossings are situated where there is reasonable evidence that the stream will remain. Again, the character of river beds varies widely, and even those of individual waterways change from place to place. The nature of the bottom naturally affects the procedure followed in excavating the trench for a pipe line, as do other factors such as depth and velocity of the water. The Mississippi, which has to be negotiated by all lines running from the Southwest to the eastern part of the country is, because of its width, depth and erratic nature, a difficult stream to cope with. Locating a suitable site involves considerable preliminary study, and laying the pipe itself is a big undertaking that often costs a million dollars and more.

Throughout most of its length, the Mississippi has a soft bed, which is normally excavated with the aid of suction-type dredges. Some other streams differ greatly from it and from one another. Those in mountainous sections, for example, are generally well confined in rather narrow valleys that prevent them from changing their courses materially, while their beds along most stretches are usually of rock with little or no overlying fine material.

Such rivers are as a rule narrow, but the Susquehanna, which crosses eastern Pennsylvania in a generally north and south direction and empties into Chesapeake Bay in Maryland, is wide and relatively shallow throughout much of its course. During this past summer it was unusually low because of a record-breaking drought, and this circumstance produced some strange conditions for the contracting firm of Pentzien, Inc., of Omaha, Neb., which was installing dual natural-gas lines across the stream for Texas Eastern Penn-Jersey Transmission Corporation. Late in August, for instance, the stream was so shallow that the drill barges were moved around by crawler-mounted tractors running on the water bed, and men in a hurry simply rolled up their trousers and walked out to the working sites. Then there came a day when the boats could no longer float, and the small amount of drilling that remained was done by conventional twin drills hung from side-boom tractors.

The 265-mile line, which is scheduled to go into service next month, will extend from the Oakford storage field near Delmont, Pa., 35 miles from Pittsburgh, to a point near Lambertville, N.J., where it will connect with the main Texas Eastern Transmission Corporation pipe line that runs from Texas to New York City. The new line is 24 inches in diameter

DRILL BARGE AT WORK

The SD-65 submarine piston drill, with its 20-foot steel that has a piece of sand pipe around it, is shown here as it is about to be lowered to the river bed. What appear to be posts in the water are casing through which the holes were loaded with powder. When this picture was taken the water level was so low that a bull-dozer with a rear-end winch was used to move the boat between drilling points.

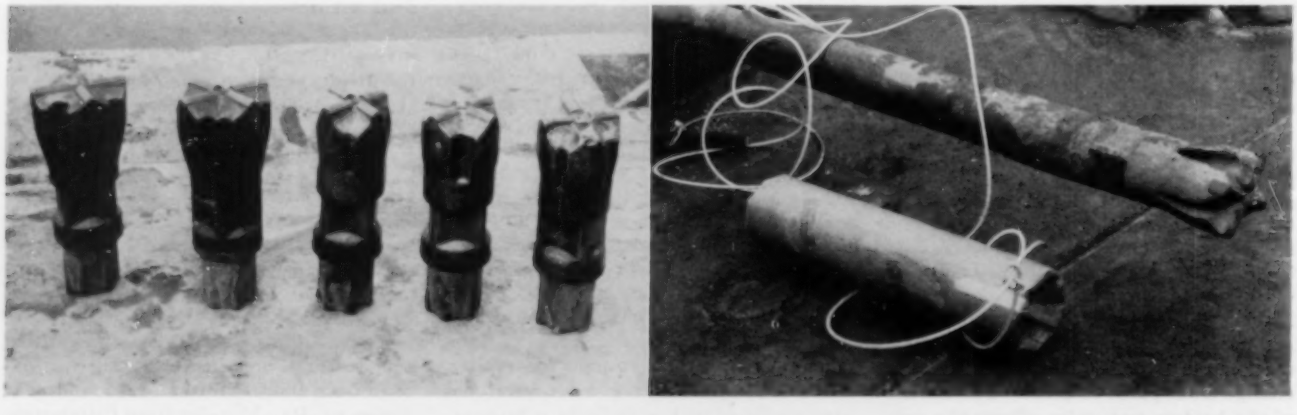
except at river crossings, where an additional 16-inch section was laid as a precaution in case one of them should break. Four other major river crossings besides the Susquehanna are involved in the project. Two of them, the Conemaugh and the Juniata, were contracted to Pentzien, Inc., and the others, the Schuylkill and the Delaware, were awarded to the Missouri Valley Dredging Company.

From valve stations on both banks, where the dual subaqueous sections tie in with the single overland conduit, the Susquehanna crossing is 5936 feet long—well over a mile. All but a few hundred feet of it on each side and a short stretch across a small island near the center of the stream is underwater, the river at that point measuring 5062 feet from high bank to high bank. The two lines occupy individual trenches, separated by 50 feet, with the 16-inch branch downstream. The general scheme was to excavate the trenches, pull the pipe into place and then backfill the openings. Specifications called for a minimum of 3 feet of coverage, and, to be on the safe side, the contractor drilled the blastholes an average depth of 10 feet and a maximum of 14 feet.

Pentzien got on the job about June 1, at which time the water averaged 5 feet deep in the working zone. As the bottom consisted of rock, with little or no overburden in most places, drilling and blasting were mandatory, and the company decided to do the drilling from floating equipment of its own design and construction. It built two barges and equipped each with a different machine. Most of the work was done by the one carrying an Ingersoll-Rand air-powered piston-type submarine drill, which is essentially a modern but smaller version of the units that achieved their first success on Panama Canal drill boats.

The newer type, designated as the SD-65 submarine drill, is an adaptation of the QD-65 designed a few years ago for Ingersoll-Rand's Quarrymaster, a huge self-contained, self-propelled heavy-duty machine that is now widely utilized for putting in large-diameter blastholes in quarries, open-pit mines and on large construction jobs such as the New York Thruway. The SD-65 has a 6½-inch bore and 10-inch stroke, strikes 200 blows a minute and, like the QD-65, can use 4¾-, 5½- or 6-inch Carset bits.

Experience has shown that the piston drill is better adapted for submarine work than the newer, faster-striking hammer drill which serves well-nigh universally for small-hole blast drilling. In the case of the latter unit, which ordinarily employ sdrill steel not more than 2 inches in diameter, the relatively small bit tends to slither around and slip off boulders when they are encountered and, hence, bind in the hole.



DRILL BITS AND POWDER

At the left are five Quarrymaster Carset bits as they appeared after they had collectively drilled almost 2 miles of holes in the river bed. The two at the left were originally of 6-inch gauge and the three others of 5½-inch. All were worn down approximately ¾ of an inch. Only one carbide insert (in right-end bit) was damaged by the hard service. The other picture shows a new 5½-inch bit that was used for only a few hours. It is attached to the hollow drill rod that started and finished the job without needing attention. Below it is one of the 4½x22-inch dynamite cartridges.

DETAILS OF DRILL TOWER

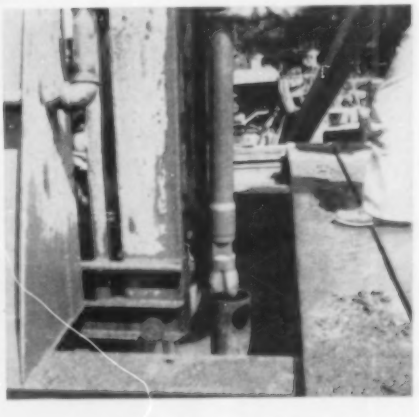
The view below shows the back of the base of the 35-foot tower on which the SD-65 drill was mounted. The tower was hinged on a trunnion on the structural-steel base so that it could be laid back in horizontal position, as seen at the right. The weight is distributed so evenly that the drill and slabback at the bottom nicely balance the upper part of the tower. The whole assembly, with the air hoists that served it, was erected on steel skids so that it could be readily removed for shipment to another job. In the right-foreground of the picture at the right is a 3-drum winch that could maneuver the barge by means of wire ropes running to shore points or to "deadmen" in the river. Beyond the winch is the radiator of the 500-cfm compressor that supplied air for the drill and the tower hoists.

Then, too, if sand or pebbles get into the hole, the steel often becomes stuck and is difficult to extract. On the other hand, the piston drill, with its large-diameter reciprocating rod and attached bit, works with a punching motion that seems to grind up material beneath and behind it. The whole assembly is sturdy enough to take the punishment without damage.

On the Susquehanna crossing job, the SD-65 was mounted on a heavy slabback that traveled up and down on a 35-foot structural steel tower. The barge, measuring 21x53 feet, was composed of six steel-plate pontoons, each 7 feet wide, 26½ feet long and 3½ feet deep. These were assembled in three tandem groups joined together side by side with steel pins run through matching steel-plate "ears" working on the principle of old-style railroad-car couplings. About 6 feet of the forward end of the central pontoon section was cut off to form a block U-shaped recess. The tower was erected at the edge of the base of the U, and planks laid across the opening in front of the drill and supported by the flanking pontoons provided a working platform for the drillers.

As accompanying photographs show, the tower was trunnion mounted so it could be pulled down and laid in horizontal position. The slabback and drill served as counterweights, and the weight was distributed with such precision that the tower was almost in perfect balance on the trunnion. In addition, the base was set on horizontal steel members or skids by means of which the entire assembly could be readily moved from the barge and loaded on a truck or railroad car for transportation to another job. At the base and just back of the tower were two Ingersoll-Rand air hoists: a large unit that raised and lowered the slabback and drill and a smaller one that handled drill steel, sand pipe, etc. A 500-cfm diesel engine-driven compressor stationed aft on the boat supplied operating air for the drill and hoists.

The barge was equipped with spuds, one at each forward corner, and these were lowered to the water bed to keep that end steady for drilling. Provision for holding the floating platform against the current and for moving it consisted of three wire ropes: two extending from the bow and one from the stern to points on shore or to "deadmen" set in the



SEATING CASING

The power of the drill was used to drive casing through which powder was loaded into the holes.

river at suitable places. These lines were run on and off their respective drums on a gasoline engine-powered winch. Because of the low and continually falling water level, however, it was not necessary to use this gear to any extent or to resort to one of two available small steel-hull boats propelled by outboard motors. Instead, it was possible for a bulldozer with a rear-end winch to travel the stream bed, and that machine was utilized much of the time to nudge the barge the short distance between hole locations. It also pushed a lot of the overburden and loose rock out of the paths of the drill rigs.

Trenching was started on the east bank and carried out as far as the island near the center of the stream. The crews then moved to the west bank and again worked towards the middle. In the beginning, the trench for the 16-inch pipe was excavated first. Some of the broken rock was deposited downstream in a ridge and the remainder was cast upstream and then leveled off with bulldozers to form a slightly inundated road to serve as a haulageway for equipment and as a working base in digging the upstream trench. This plan had to be modified somewhat later when the time limit for completing the 24-inch branch was moved ahead from October 1 to September 1.

Holes for each trench were drilled in two parallel rows spaced 42 inches apart. Those in each line were also normally spaced on 42-inch centers and staggered in relation to those in the neighboring line. When drilling, the bit worked inside a piece of 7-inch sand pipe that rested on the river bed and was long enough to extend above the water surface. This kept sand and gravel out of the hole. After drilling was completed, the bit was withdrawn and a length of 5½-inch casing lowered inside the larger one and bottomed partly in the hole, a few blows on top of it with the drill bit forcing it down to insure a secure fit. The hole was later loaded with powder through this casing, which was then removed with the aid of a line from the small air hoist.

In the area under consideration, the Susquehanna crosses many miles of successive ridges of the Appalachian Mountains at a considerable angle, forming one gap after another. The ridges are composed mainly of alternating layers of various sedimentary rocks that have undergone folding and structural changes as a result of long geological processes. On the river bed, narrow bands of the more resistant formations rise a little higher than the softer intervening material and are naturally the first to be exposed when the flow of water decreases. These strata dip at an angle of around 60° from the horizontal, and the pipe line intersects them at a slight angle to their strike.

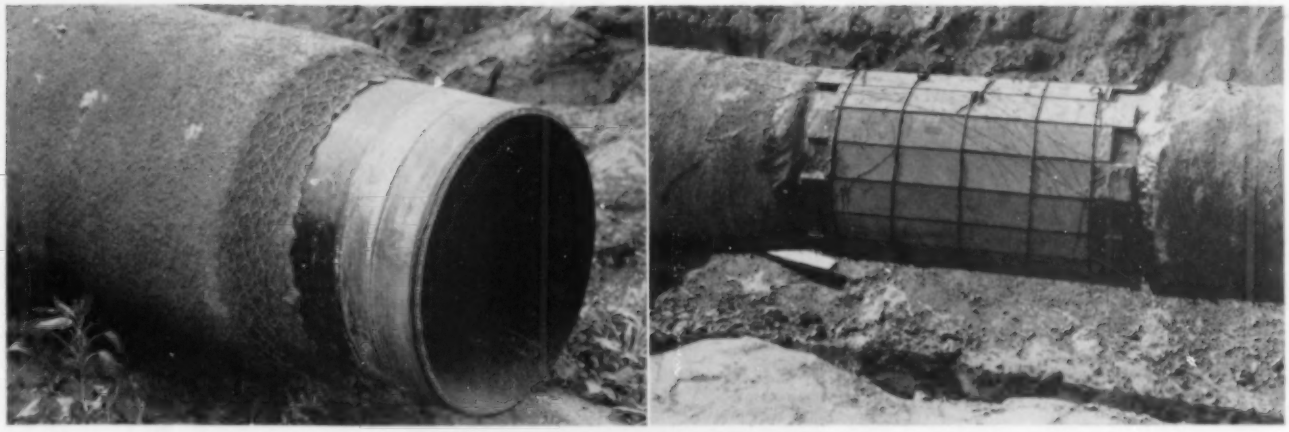
Approximately 60 percent of the drilling was in red shale, in which progress was fast, and the remainder was either in rock of granitic origin or in quartzite, both of which were much harder than the shale. All told, the SD-65 drilled 1075 holes, about 10,750 feet in the aggregate, or slightly more than 2 miles. The machine averaged around a hole per hour, or from 18 to 20 holes in two 10-hour daily shifts. This included all down time such as blasting periods, when the barge had to be moved downstream well out of range, and also days when no drilling was done. Actual drilling time was 30 to 35 minutes per hole.

Virtually all this work was done with five Carset bits—two of 6-inch gauge and three of 5½-inch. Another of the latter size was put in service during the closing days, but was used only slightly. As an accompanying picture shows, the bits finished the job in generally good condition and with considerable footage left in them. All were worn down in gauge approximately ¾ inch, practically to the same diameter as their bodies or stems, but in just a single case did one of the tungsten-carbide inserts (there are four in each bit) sustain damage, and that was not serious enough to interfere materially with the bit's effectiveness. Only one drill bar or rod was used during the weeks of work, and at the finish it was, to all appearances, as good as new. It is made of alloy steel, is 20 feet long and has an outside diameter of 3¾ inches and a central 2½-inch hole for the passage of air to blow out the hole.

Holes were loaded with two kinds of powder, both in 4½x22-inch cartridges weighing 16⅔ pounds. In the bottom of each hole was placed a charge of "high-velocity" gelatin dynamite, which has great resistance to disintegration in water. On top of it were put either two or three cartridges of ordinary gelatin dynamite, followed by some sand stemming. Primacord, which was used for all firing, was connected to the water-resistant unit. It is believed that in most instances the Primacord detonated the upper cartridges first, but there was always the assurance that if this failed to happen the bottom one would explode those above it. Holes were loaded soon after they were drilled. To the end of the short piece of Primacord extending from each of them was attached a small

PERSONNEL

Forrest Andrews, superintendent (wearing hat), and Clarence Zarn, his assistant, posing (left) just after walking out of the river. Roger Pentzien, a member of the firm, also spent considerable time directing the job. Members of the drilling crews are shown above aboard the SD-65 drill barge. From the left they are: Harry Benning, Orbon Wallace, Walter Clayburger, Roland Blass, T.D. Stout, foreman, Harold Asper, Foster Minnich and Austin Johnson. This picture shows the bow of the barge with the central U-shaped opening and the drill mounted at its base. Planks were laid across the gap to provide a platform for the drill operators.



WEIGHTED PIPE

At the left is shown a piece of 24-inch pipe covered with concrete reinforced with chicken wire to prevent it from floating. A 40-foot length weighs around 16,000 pounds and has a negative buoyancy of about 100 pounds per linear foot. Joints between lengths were encased in wire-bound wooden strips after welding (right) so that the coating of bitumastic enamel would not be scraped off when pulling the line into the trench and backfilling the latter.

block of wood which floated in plain sight until the time came to make the connections for firing. Fifty or more holes were ordinarily blasted at a time, but one group of 650 was shot near the close of the work. Approximately 90,000 pounds of explosives was consumed.

Blasting produced a trench with a V-shaped cross section up to 25 feet wide at the top. The broken rock that was not thrown aside was excavated with Bucyrus-Erie, Koehring and Northwest draglines equipped with buckets of ¾- and 1½-cubic-yard capacity. Each of these crawler-mounted machines built its own roadway in the trench as it moved along, first depositing rock behind it for that purpose and then, using that stretch as a base, removing material from in front of it and piling it alongside the trench.

Both the 24- and 16-inch seamless-steel pipe laid in the Susquehanna River section are of extra-heavy construction, having walls ½ inch thick. As received from the mill, the 24-inch size in lengths of approximately 40 feet weighed about 130 pounds per linear foot. This was increased to more than 400 pounds before putting it in place by covering it with concrete mixed with the heavy mineral barite and reinforced with chicken wire. Prior to that the pipe was given two coats of bitumastic enamel to protect it against corrosion. Sections that were to remain straight were delivered to the contractor already encased in concrete; those that had to conform to the contours of the terrain at the edge of the stream were bent in his yard on the east bank. The coated 24-inch line had a negative buoyancy of around 100 pounds per running foot and the 16-inch about 60 pounds, based on the specific gravity of water as 1.00.

LOADING HOLES

At times during the latter stages of the work the water was so low that powdermen walked from one hole to another.

The pipe entered the open trenches in the river from the eastern shore, additional sections being welded on as the strings extended farther into the water. Pulling power was supplied by a Fred Cooper winch which was placed at convenient points where lines were attached to deadmen and heavy pieces of equipment to give it the required stability to do the job. All welds were X-rayed with portable equipment by Industrial X-ray Engineers. After the completion of a weld, the adjacent uncovered areas were doped with enamel and encased in a protective jacket of wooden strips wrapped with wire. Once the lines were in position, the trenches were backfilled by the draglines.

The pipe line will have a carrying capacity of more than 200 million cubic feet of gas daily. This fuel, stored by Texas Eastern in the Oakford field during the summer period of slack demand, will be withdrawn in the colder months, transmitted and turned over to Transcontinental Gas Pipe Line Corporation, which will deliver it to its customers. Under the agreement between these concerns, Texas Eastern can store 12 billion cubic feet of gas yearly for this purpose, the gas coming from Transcontinental originally. Thus Texas Eastern will merely perform a storage and transmission service and, in connection with it, will operate the new line. In addition to the latter, the project called for a 3300-hp compressor station near the storage field to boost the pressure of the withdrawn gas prior to its transmission. The cost of the line and appurtenant structures is estimated at $31 million.

The Oakford storage reservoir, a 19,000-acre depleted natural-gas field, is owned jointly by Texas Eastern and New York State Natural Gas Corporation, a subsidiary of Consolidated Natural Gas Company. It began to receive gas in 1951 through a 774-mile, 30-inch line that Texas Eastern laid from Kosciusko, Miss., to near Connellsville, Pa., and thence 35 miles to the Oakford storage reservoir. It has also constructed a compressor station near the field to inject the gas into the ground. This has a total capacity of 30,000 hp, and is now in service. The underground reservoir has two storage horizons. The upper one, called the Murrysville Sand, will hold 85 billion cubic feet of gas of which 52 billion will normally be withdrawn during the winter months. The lower zone, or Fifth Sand, will absorb 20 billion cubic feet of which 8 billion will usually be taken out in winter.

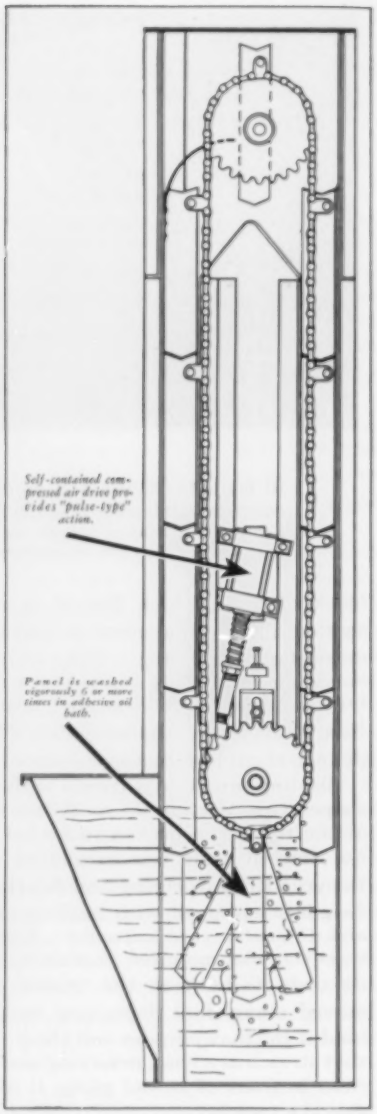
Pentzien, Inc., started out in Omaha in the 1930's as the Omaha Dredge & Dock Company, a partnership which was dissolved in 1950. Then two companies were formed: Pentzien and The Missouri Valley Dredging Company. The latter constructed the Schuylkill and Delaware river crossings of the Oakford-Lambertville line.

Pentzien's Susquehanna job has been in charge of Forrest Andrews, superintendent, and his assistant, Clarence Zarn. Roger Pentzien, an official of the firm, divided his time between this operation and others the concern had underway. T. D. Stout and Edward Mueller were drilling superintendents and J. C. Smith had charge of the pipe work.

PROTECTING MEN AND MACHINES FROM DUST (PART II)

The Devices Available for Doing This Are Many and Varied

Robert J. Nemmers


Self-contained compressed air drive provides "pulse-type" action.
Panel is washed vigorously 6 or more times in adhesive oil bath.

VISCOUS-FLUID FILTERS

The two belt-type filters shown are both cleaned automatically with the aid of compressed air. The Air Maze at the right operates much like a Ferris wheel. Interlocking panels are cycled through the unit by an air cylinder acting on a ratchet device. As only one face of each panel is presented to the incoming air stream, re-entrainment of dust particles is prevented. The pulsating movement imparted by the cylinder to the belt and panels results in shaking each panel vigorously at least six times during its travel through the oil bath and therefore in thorough cleaning. The other filter, made by Dollinger Corporation, has two endless belts of wire mesh. The one on the inlet side passes through an oil bath, the other one does not. This, in effect, is a combination wet-and-dry type filter and makes sure that none of the adhesive oil will be entrained in the air stream. The belts are cycled by an electric motor, and each one is cleaned by jets of compressed air. In both filters dust and dirt are removed as sludge from the bottom of the oil reservoir.

THE various types of air-cleaning devices in use can be broken down into several distinct classifications, and for simplicity's sake we will treat them in groups which differ in the way separation is effected.

Filters

This is the most important type from our standpoint and can be divided into at least four groups:

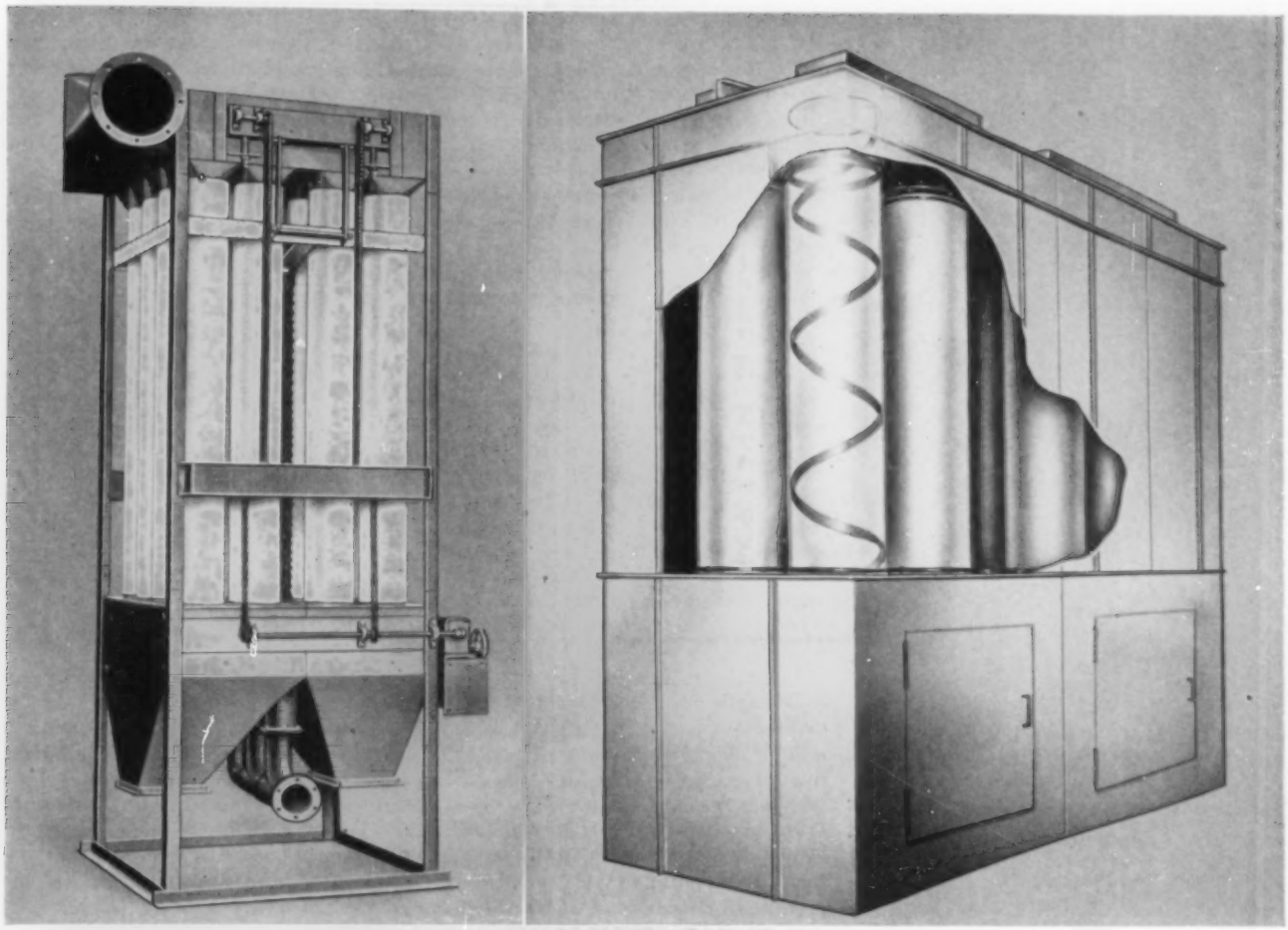
1. Protective units for air compressors and internal-combustion engines, as well as for air-conditioning systems. These are intended for the removal of normal contaminants from large volumes of air. Efficiencies range from less than 50 to 99 percent (weight).
2. Cloth filters for heavy dust loadings. Efficiencies as high as 99.9 percent (weight) are not uncommon and the discharged air is clean enough to meet most requirements.
3. Filters made of such materials as compressed glass fibers, cellulose-asbestos paper, resin-impregnated wool or deep beds of sand. Their efficiency is high—virtually 100 percent—and they are used for the final cleaning of air that must be as free as possible from contaminants.
4. Filters worn by individuals to protect them against heavy concentrations of dust.

Class No. 1 includes disposable, semipermanent and permanent units of two broad types—viscous and dry. The viscous filter is coated with an "adhesive," a sticky substance that helps to catch particles in the air stream and prevents them from being reëntrained. The adhesive, usually an oil or grease of low volatility, is also a good wetting agent. The filtering medium is generally glass wool, hemp or other vegetable fiber, animal hair or wire mesh and is placed in a boxlike enclosure several inches deep and varying in area. Normally, the fibers are packed with increasing density from front (air inlet) to back (air outlet), the idea being that most of the large particles will be removed before the more compact section is reached, thus lengthening the service life of the unit.

When resistance to air flow becomes excessive, the disposable filter is discarded for a new one. In the case of a semipermanent installation the packing may be taken out for washing and reoiling, or it may be equipped to perform these operations continuously. One of the latter variety, which is illustrated, is made up of two wire mesh-panel belts one of which moves through an oil bath where the dust settles and forms a sludge. Because viscous-type filters clean air by impaction of the aerosol particles on the coated fibers, high air velocities—250 to 600 fpm—give best results. Their efficiency ranges from 85 to 90 percent, and more in some cases.

Dry separators are similar to the viscous type in area though their depth is often greater and they have about the same kind of filter media. Because adhesives are eliminated, their air passages are normally smaller than those in viscous units of like efficiency and it is therefore necessary to operate them at lower velocities. However, it is possible to increase their effective surface area from ten to fifteen times by pleating the media like an accordion.

When pressure drop in a dry separator becomes excessive, the whole unit or cell



BAG FILTERS

Shown are two types of bag filters one of which is cleaned mechanically and the other by compressed air. In the latter (left), the Amer-Jet made by American Air Filter Company, a chain sprocket drive on the front serves to carry individual rings around each bag up and down. Jets of compressed air issuing from the rings dislodge dust, which falls into hoppers below. The other collector, called the Spirokleen, is manufactured by Turner & Haws Engineering Company. It is cleaned by a spiral wiper blade which revolves inside the bag and scrapes off the deposits, which likewise drop into a hopper. Other filters of this type are vigorously shaken at intervals to effect cleaning.

is generally thrown away, although there are some types that can be easily cleaned and reconditioned. Others can be automatically cleaned by periodically causing them to vibrate or by manually reversing the air flow at fixed intervals. Although it is best to be governed by manufacturers' recommendations in the disposal or cleaning of both viscous and dry filters, rule of thumb dictates action when the air flow has been cut by 10 percent, or the pressure loss is twice as much as it was initially.

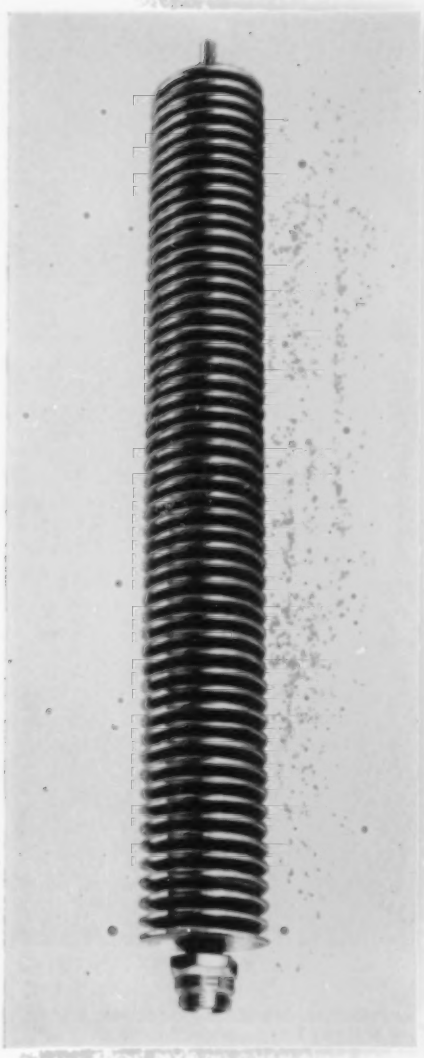
Cloth-bag filters are exactly that—bags of cloth through which the dirty air passes, leaving dust and other foreign matter clinging to the inner surfaces. They are from 5 to 20 inches in diameter, from 2 to 30 feet long, and suspended vertically with the open ends attached to an inlet manifold at the top and/or the bottom. As the polluted air enters the manifold, it strikes a baffle which causes the larger particles to drop out of the air stream, which then proceeds on its way through the bags. This type may be cleaned either by shutting down the unit and shaking the bags or, as in the case of those illustrated, by some automatic means. Filters so equipped use air at a considerably higher velocity than the usual shakedown type. A "pillow case" pulled over a frame may be substituted for the bag, the dirt-laden air flowing through the envelope into the collector and thence to the discharge. Cleaning is done by shaking the frame.

Cotton is the most common bag material, especially for cold noncorrosive aerosols. Wool felt and fabrics woven of glass, asbestos or Du Pont Orlon also have been utilized. The cloth-bag type is designed primarily for treating dry dusts or fumes at moderate temperatures, work in which efficiencies as high as 99.9 percent have been recorded. It is less effective in handling mists. Another factor that may limit its use is the size of the installation, which is necessarily large.

A normal man takes in every day 3 pounds of food, 4 pounds of water and 34 pounds of air. With the air he consumes varying amounts of dust, pollens, smoke and other pollutants, depending on where he lives.

High-efficiency filtering media are many and varied but generally consist of specially manufactured fine-fiber paper such as cellulose-asbestos. Others are composed of compressed glass fibers and composite pads of glass fibers or of resin wool. One type of filter designed for underground use has a container packed with sand which varies gradually from coarse granules at the inlet to fine at the discharge. Though expensive, it is valuable for cleaning air laden with corrosive mists. No disposal problem is involved, for when the sand plug is no longer fit for service it can stay buried and forgotten.

Other filters in the high-efficiency field that rate special mention are the porous-stone, porcelain- or stainless-steel types. The latter is made by sintering powdered metal and converting the material into sheets that can be shaped—given ribs or fins that provide a large surface area in



PLEATED TYPE

The filtering element of a unit manufactured by Micro-Metallic Corporation. Air entering the container in which it is housed filters through the porous sections, which are made of the sintered powder of stainless steel, and leaves by way of the bottom. The accordionlike pleats increase the filtering area many times. This type of separator is especially suitable for service involving high pressures and temperatures and corrosive conditions.

relation to size, as shown directly above. Their cleaning is somewhat complicated, as it necessitates boiling first in a caustic solution and then in a dilute acid solution, followed by a clear-water rinse. However, they can be constructed to function at high pressures and temperatures and have the advantage of resisting all but those corrosive elements that attack stainless steels.

Filters for personal use are perhaps the oldest in the world. There are frequent references throughout literature of cloths soaked in water to prevent inhaling dust and smoke. In the heyday of the American cowboy, neckerchiefs served to protect the lungs rather than to hide the faces of the bad 'uns, and they are worn for that purpose even today. From these first makeshifts came masks that were designed especially for the protection of workers in dusty places. Offshoots of these are firemen's respirators which, in addition to filtering, adsorb dangerous gases by passing the air through small beds of activated charcoal or alumina. This, too, is the principle on which the gas masks of the Armed Forces are based. One was actually constructed on the principle of the electric precipitator, but the idea was abandoned because a unit small and light enough to be readily portable was unreliable.

Electric Precipitators

Electrical precipitation has a wide field of application in large industrial establishments and public utilities as well as in metallurgical and chemical plants, in the former to remove fly ash and in the latter to trap fumes and acid mists. Because cleaners of this type can be made of corrosion-resistant materials, they are suitable for service where hot and corrosive gases and run-of-the-mill aerosols are encountered. There are two classes: the Cottrell precipitator, and what is referred to as the 2-stage machine. The Cottrell unit is of the single-stage type; that is, charging and deposition take place at the same time in the same electrical field. In the 2-stage precipitator the particles are subjected successively to a charging field and then to a deposition field—they first receive a positive charge of electricity and then accumulate on negatively charged plates. The latter system is presented schematically in this article.

In Great Britain the Department of Scientific and Industrial Research estimated a few years ago that 2½ million tons of coal issues annually from chimneys in the form of smoke and that this amounts to only one-third the volume of accompanying invisible gases. Thus the total loss of coal, caused mainly by poor combustion, is 10 million tons, all of which winds up as atmospheric pollution.

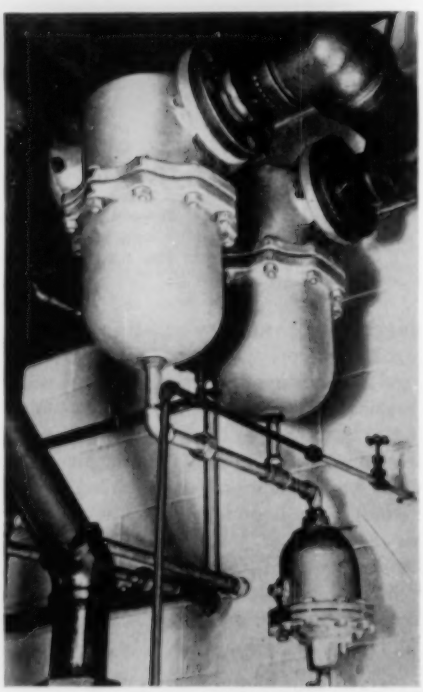
Ordinarily, the two types are cleaned by shutting them down and washing the collector plates with jets of high-pressure water, but machines that do this work automatically have been devised. One of these has several collectors mounted on a moving belt which periodically dips them into a water or oil bath. Both precipitators operate on rectified alternating current: the 2-stage unit at around 12,000 volts in the charging or ionizing stage and 6000 volts in the collecting stage; and the Cottrell machine at 24,000 volts and more. Either one offers little resistance to the flow of air. When bone-dry dusts are being handled it is sometimes necessary to inject a water mist to improve the conductivity of the already deposited layers of dust. Efficiencies are high, frequently in excess of 98 percent and sometimes more than 99 percent (by particle count).

Settling Chambers

The settling chamber is the simplest form of air-cleaning device; it is just a long boxlike unit through which the contaminated air passes at low speed to permit separation of the entrained particles by gravity. It is used mostly for collecting extremely heavy dust concentrations, but also products such as powdered milk. Refinements include mesh screens, to slow down the movement of the air, and shelves to increase the collecting area. However, none of these filters does a thorough job even though the capacity is high. They serve an important function as precleaners where low velocity and large space requirements are permissible.

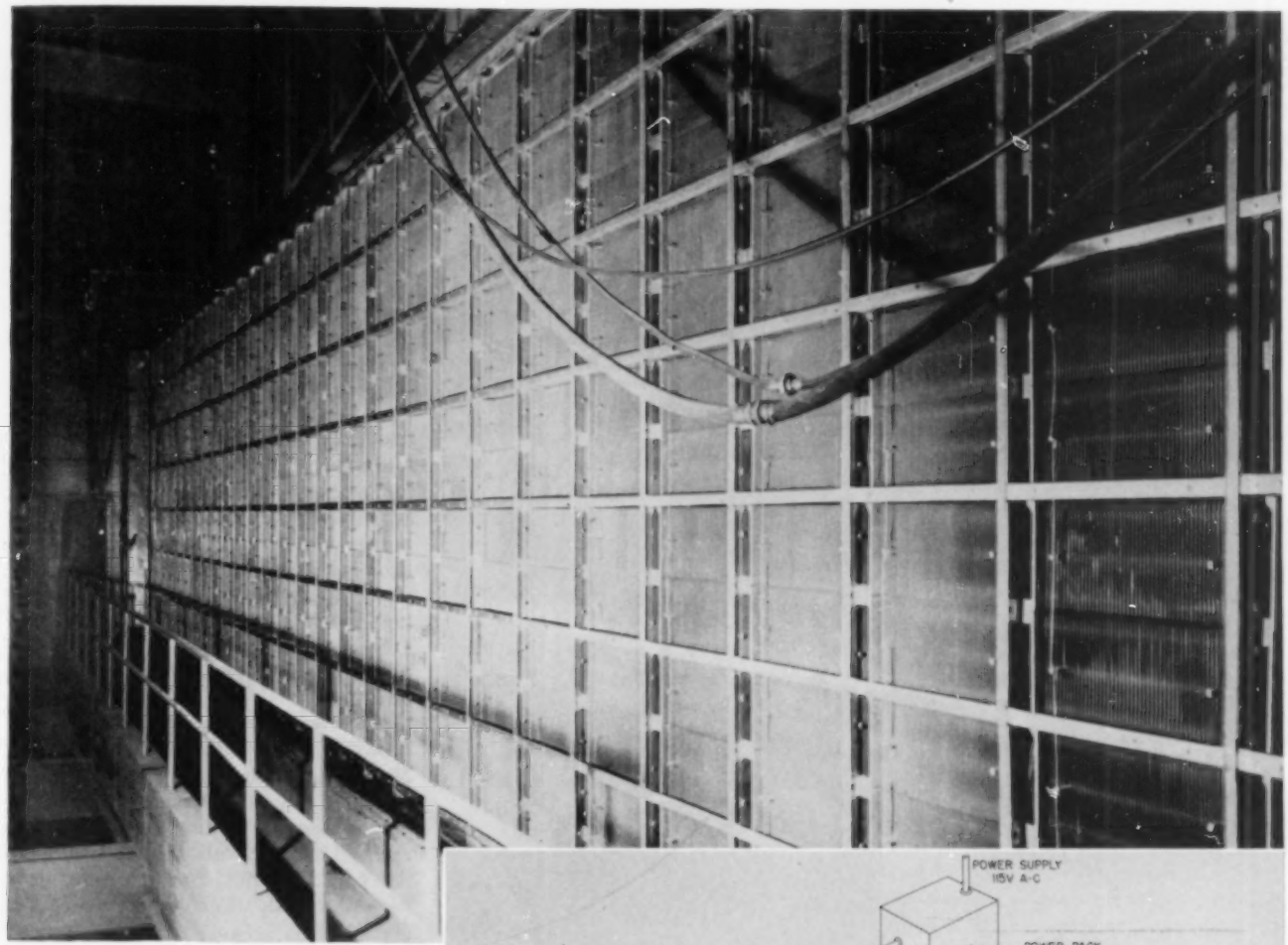
Air Washers

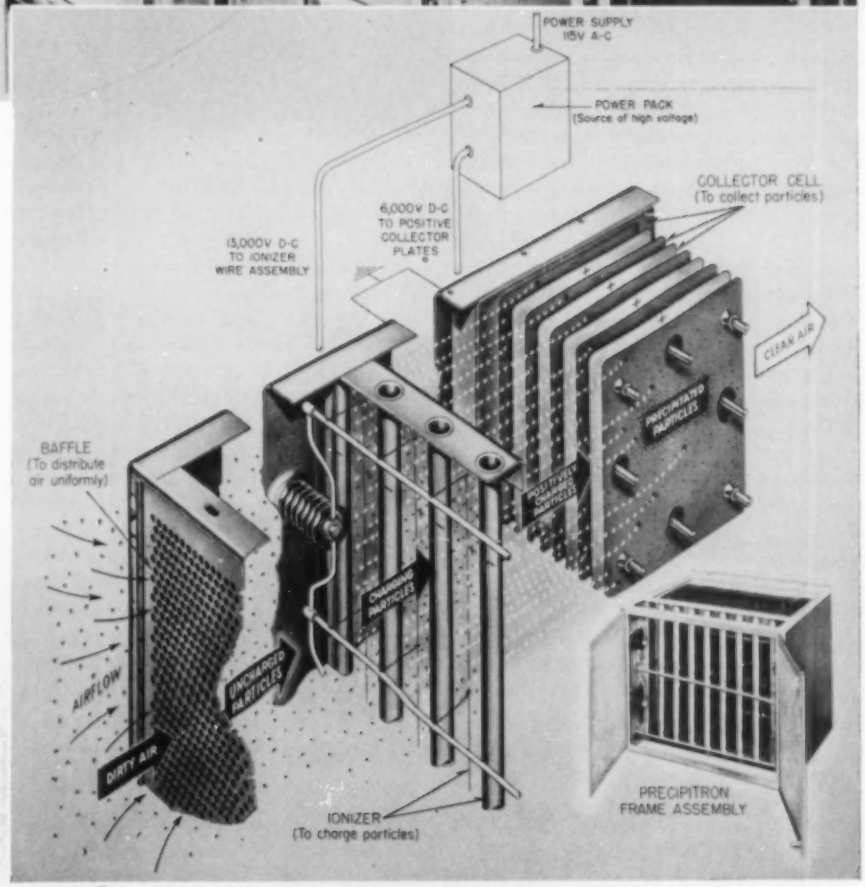
Air washers are only moderately successful as cleaners but serve a very useful purpose in controlling dew point in the air-conditioning field. In equipment of this kind the air generally flows through a chamber in which banks of



AIR-LINE SEPARATOR

The Johnson separator shown combines two principles of operation. Entering air is reduced slightly in velocity to effect the removal of much of the entrained dirt and moisture. The air then passes through several layers of coarse-mesh screen arranged in a labyrinth of baffles. Rapid changes in the direction of flow cause the remaining dirt to drop out. The installation pictured consists of two 4-inch separators and cleans 500 cfm of free air at 90 psi. The small pipes leading from the bottom drain the moisture into an automatic trap.





STEEL-MILL APPLICATION

Westinghouse Precipitron air-cleaning equipment handles 210,000 cfm of air at the Fairless Works of United States Steel Company at Morrisville, Pa. A section of the installation is shown at the top. The perspective drawing illustrates the Preciptron's construction and method of operation. As the air passages are little restricted the pressure drop is small.

nozzles are mounted at varying levels. These spray water into the air stream, sometimes against it or in the direction of the flow, or even in both directions. At the discharge end are baffles arranged in a zigzag pattern which collect most of the large mist particles as well as any entrapped dust.

Wet Filters

Separators of the wet type are composed of groups of cells usually containing glass fibers. They are set at an angle to the air stream and are kept moist by a continuous fine mist of water directed against them from above by nozzles. The air flows through the filtering medium and then comes in contact with a baffle-plate arrangement, much like that at the outlet of the air washer, where any entrained moisture is deposited. Wet filters are especially suitable for treating acid mists and certain vapors. They are not intended for handling hydrophobic substances. Both air washers and wet separators have one thing in common: the waste is in the form of a liquid, which is often easier to dispose of than a solid.

Spray Towers

Where plenty of water is available, spray towers are frequently used as coolers and primary cleaners in treating blast-furnace gas and in ridding smoke of

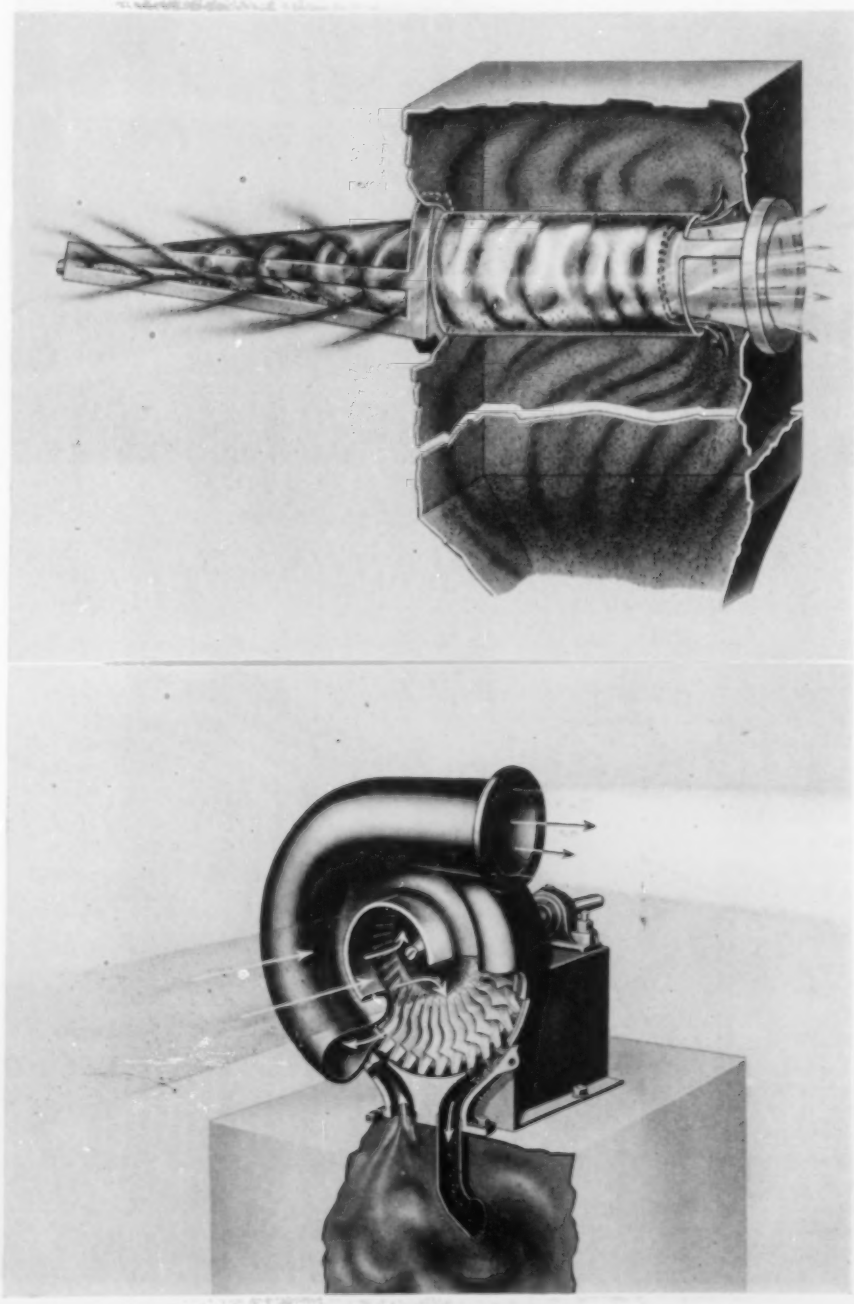
cinders and fly-ash. In operation, the air flows into the tower tangentially and whirls through sprays of water to effect the removal of most of the particles carried by it. Where greater separation is desired, the centrifugal force is supplemented by baffles interposed in the air stream to change its direction rapidly.

Centrifugal Separators

In this category are two types: wet and dry. The latter, in turn, is divided into two classes: cyclones and baffle chambers. The cyclone consists of a cylinder, ½ to 15 feet in diameter, which terminates in an inverted cone at the base. The air enters tangentially at the top, and in its passage toward the tip of the cone the centrifugal force imparted to it hurls the entrained particles against the walls of the cylinder and cone. The solids drop into a collecting hopper while the cleaned air flows up and out through a tube in the cylinder. Cyclones are depended upon extensively in areas where dust loads are heavy, for the removal of condensed water vapor in air distribution systems and for other similar applications.

There are variations of the basic design, including a bank of small cyclones to be used instead of a single large unit, a setup that will handle the same volume of air with increased efficiency. There is a type with annular vanes in place of the tangential entry port to impart the whirling motion to the air. Another centrifugal separator incorporates a turbinelike impeller in a cast housing. As the air flows through the latter the fan blades direct the dust into a collector chamber. One of these, a Type D Roto-Clone, is illustrated. By still another method the air stream is made to whirl by putting baffles or obstacles in its path. If it moves fast enough, the particulate matter will strike the obstructions and drop out of suspension while the air continues along its course. This type is highly efficient where the aerosols involved are large and is frequently used as a precleaner (as ahead of a cloth-bag filter).

Wet centrifugal separators are sometimes known as inertial scrubbers and create and apply the whirling action in the same way as does the dry type. The only difference is that a fine mist is sprayed into the air stream before its entry into the unit. Spray towers, dealt with previously, do not come under this classification because the air is sprayed with water inside the separation chamber, not ahead of the inlet.



CENTRIFUGAL FILTERS

Two applications of the principle of centrifugal separation are illustrated by the Amer-Clone (top) and the Roto-Clone, both products of American Air Filter Company. Air is admitted to the former through annular vanes that produce the necessary rapid rotary motion. In the Roto-Clone a turbinelike impeller provides the centrifugal force. The dust is directed into a hopper that forms the base of the unit.

Miscellaneous

This article would not be complete without some mention of the most modern air cleaner, the supersonic-sound generator, which is fast gaining favor in certain fields of application. The high-frequency waves produced by this device cause many small particles in the air to come together and form a single large one, thus simplifying removal. Supersonic generators are often used in conjunction with secondary collectors as aftercleaners. In addition, there are separators that embody a number of the principles described, and for them manufacturers can rightly claim efficiencies somewhat higher than those obtainable with a unit operating on but a single one.

In general, all air-cleaning devices, from the largest to the smallest, are based on the fundamentals we have tried to explain. Each has a job to perform, and the choice of a filter suitable for a specific purpose depends on numerous variables; so many, in fact, that it is not possible in the space allotted to go into them here. Anyway, it is far better policy to leave that to the manufacturers, many of whom coöperated in the preparation of this article by making available much of the source material and most of the illustrations.

(Conclusion)

ADAPTABLE NYLON

In Molded Form It Has Numerous Uses In Industry

Jane S. Muller

HAMMER AND KEY CASE

Under test the nylon faces of the metal-working hammer shown above withstood 1,260,000 fifty-pound blows from a pointed instrument, lasting two and one-half times as long as the next most durable material tried. Yet nylon does not mar soft metals. The bridge and loops of the key case illustrate how adaptable molded nylon is to intricate designing. In thin sections the material is resilient and flexible but also tough, and the loops can be readily snapped into and out of position for key insertion or removal.

MORE than 2000 applications, many of them in the automotive, textile and electrical industries, have been found for molded nylon, the development of which has opened a vast new field for designers who discover new uses for it well-nigh daily. Because it combines many desirable characteristics in one product it is becoming an important engineering material, for its unique properties enable it to perform exceptionally well in many instances where metal and other plastics have done only passably well.

To quote from literature published by E.I.du Pont de Nemours & Company, which originated the highly adaptable product, its uses "have increased tenfold within the past three or four years with such diverse applications as bearing retainers for helicopters and nail-polish applicators; mechanical parts in automobiles and buttons on nylon sweaters; bearings in heavy textile machinery and gears in hand egg-beaters."

Of light weight, molded nylon has high tensile strength, toughness, chemical-, abrasion- and heat-resistance, as well as good machinability. At least some of these characteristics are behind every successful application, especially in the field of bearings, cams, gears, wear plates and other similar mechanical parts. Molding powder is available either in solid granular form, cube-cut to $\frac{1}{4} \times \frac{1}{8} \times \frac{1}{8}$ inch, or chopped to a granulation of $\frac{3}{32}$ inch, and some types come in varying colors.

Of the seven grades of powder now marketed by Du Pont, probably the one for which there is most demand is Zytel-101, which may be molded either by extrusion or injection methods. Conventional machine tools and procedures usually give highly satisfactory results with molded nylon, which can be turned, tapped, drilled, milled and sawed. Regardless of how it is fabricated, savings in the cost of nylon components are impressive owing to improved performance, faster production and more parts per unit of weight.

Nylon has better heat resistance than any other thermoplastic material and bearings made of it have, where adequately lubricated, been known to serve satisfactorily even at surface temperatures above 300°F, which is considered the highest practicable limit for molded nylon. More sensitive to dry heat than moist, continued exposure to dry heat in excess of 250°F may cause embrittlement of standard compositions. Special heat-stabilized compositions are available, however, for use at higher service temperatures. Nylon does not soften gradually, but has a specific melting point above which it develops a fluidity similar to that of lubricating oil.

The most solvent-resistant of formulas are insoluble in common solvents, inert to alkalies, and stand up under dilute mineral and most organic acids, though their resistance to acids is not outstanding. Nylon does not affect petroleum oils or grease, nor is it affected by them at temperatures up to 325°F. And by reason of its inertness to a number of chemical solutions, the necessity of using seals is obviated. Frequently, when fluids are being processed, they are permitted to serve not only as a lubricant but also as a coolant for bearings.

In bearing applications, failure usually can be attributed to overheating, which can be prevented by proper design and lubrication. Nylon has a tendency to enclose abrasive particles completely, thus restoring smooth bearing surfaces. Horn-like rather than brittle, it is harder than other flexible thermoplastics, and this, along with its low coefficient of friction, contributes to its abrasion-resistant property.

The automotive industry uses more than 50 components made of molded nylon. The suitability of this material for molding to extremely close tolerances, as well as in thin sections, has led to its enthusiastic acceptance especially in the bearing and gear field. Included among the parts are gears for distributors, speedometers, timers and windshield wipers, light-load bearings and cams, clutch shaft bearings, insulator bushings, fuel-pump valves and valve components, fuse holders, tire-valve caps, hydraulic seals and dashboard appurtenances.

Five years ago Packard Motor Car Company began experimenting with nylon and has substituted it for three brass parts in its automatic transmission: the 8-tooth speedometer driving gear mounted on the output shaft splines; the transmission governor pinion; and the speedometer pinion and shaft assembly, which was originally injection molded onto a steel shaft. In most current automobiles, the last-mentioned component has been simplified by forming both shaft and gear in one nylon mold, thus reducing production time and costs.

Sprague Devices, Inc., has started

turning out a windshield wiper that is operated by a nylon air cylinder 6 inches long. And the interior lights of many automobiles now have heat-resistant nylon lenses. Of simplified design, their flexibility permits snapping them into place without gaskets.

One of the principal reasons for the textile industry's enthusiasm for molded nylon is the fact that lubrication is not needed. In a business where spoilage of work from oil or grease may be as high as 20 percent, the use of unlubricated parts is a great factor in cutting costs. Nylon gears are placed so that no two metal gears will mesh, thus eliminating external lubrication and lessening the chances of product contamination. Today molded nylon is formed into parts for drafting and spinning equipment, looms and winding machines, as well as into thread guides, crown gears, verge plates, etc. Verge plates are used in knitting full-fashioned hosiery and must have high impact resistance and resiliency. Inserts of nylon far outlast those of other materials and provide an improved cushion for "sinker-backs"—needlelike metal components that ceaselessly pound the verge plate at high speed. An improved loom with nylon parts now on the market was tested for starts and stops equivalent to 50 years of operation without adjustment and did not show noticeable wear.

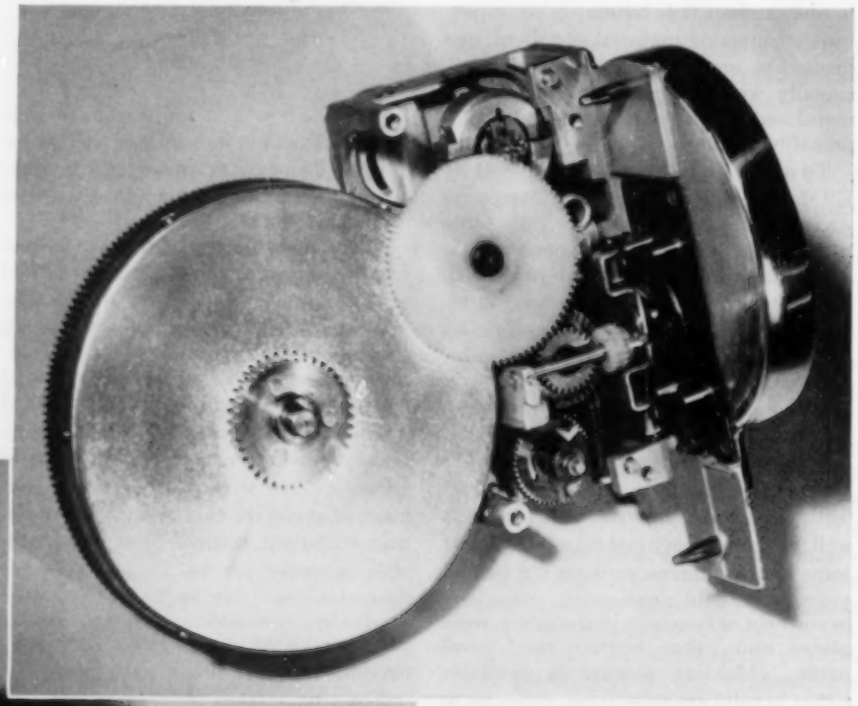
The resilience of nylon gears is a major advantage that makes it possible to replace an individual long-draft spinning unit in a matter of seconds without shutting down the entire machine. The average textile mill is equipped with thousands of these units so that the removal of one without down time for the remainder results in considerable savings. MacDonald & Sons, Inc., development engineers, have gone into full-scale production of these long-draft spinning units in which thirteen parts, including gears and bearings, are made of Du Pont molded nylon. Trial runs have indicated that nylon components will not only outwear those of other materials but will also reduce power requirements because of their relatively low coefficient of friction and light weight.

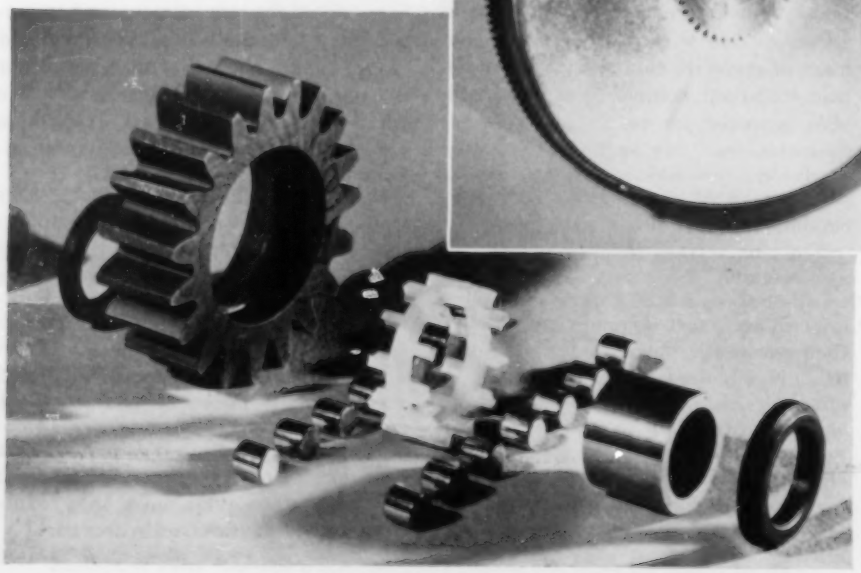
Spoilage is only one of the problems the textile industry has solved by the use of molded nylon. Teaseling or teasel gigging is an important phase of the cloth-finishing process and until World War II the nap on woven cloth was raised by means of thistles or teasels grown mostly in France and Italy. Then, when the plants were difficult to obtain, the mills turned to nylon.

Close examination of a thistle will reveal that it has numerous stiff horns each of which terminates in a tapered hook. It is the shape, flexibility and direction of these sharp hooks that effectively lifts the fibers and gives fabrics the desired finish. After being softened in hot water, natural teasels are set firmly in metal frames or slats which, in turn, are fastened to a cylinder on the gigging machine. The surface of the material is brought in contact with these slats, which are disposed at several points around the cylinder. The size of the latter determines the number of thistles required, which varies from 2500 to 4000.

The first installation of nylon-bristle teasels, which are also secured to slats, was made about twelve years ago in one of the largest woolen mills in the United States. After more than thirteen months of continuous service the experimental brushes showed little wear. The test also demonstrated that fewer runs were needed to raise the nap and that the finish was uniform and free of the streaks usually caused by defective natural teasels. It should be added that examination and replacement of worn teasels necessitated from one to two hours down time daily on each machine. Because of the stiffness, nonabsorbency and durability of nylon teasels, cloth finishing mills now expect them to last for several years.

The substitution of ultrahard carbide for conventional steel in tube and rod dies has resulted in a polishing problem that is being solved by nylon-plastic belts extruded in either flat or round section and machined into varying shapes. Commercial diamonds cannot be affixed satisfactorily to fabric belts, but when embedded in nylon the borts are cushioned and prevented from being torn out of their sockets. Where they have been so mounted and used to polish inside ball-bearing races and out-



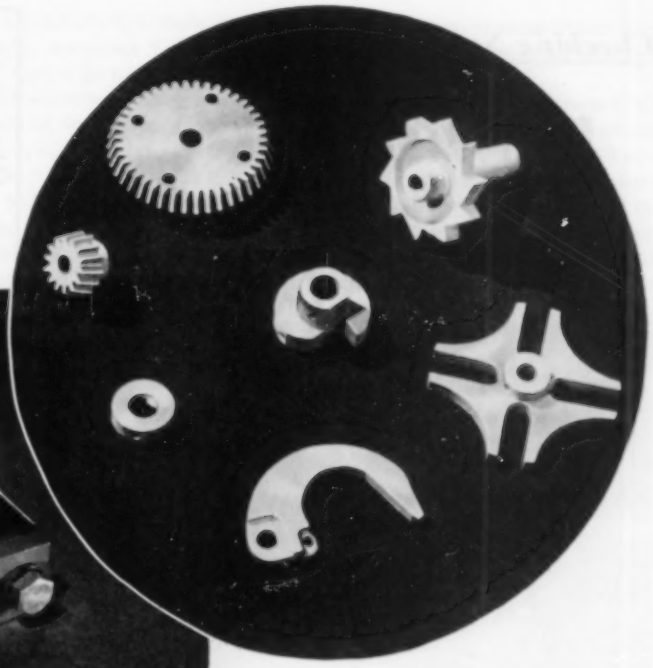


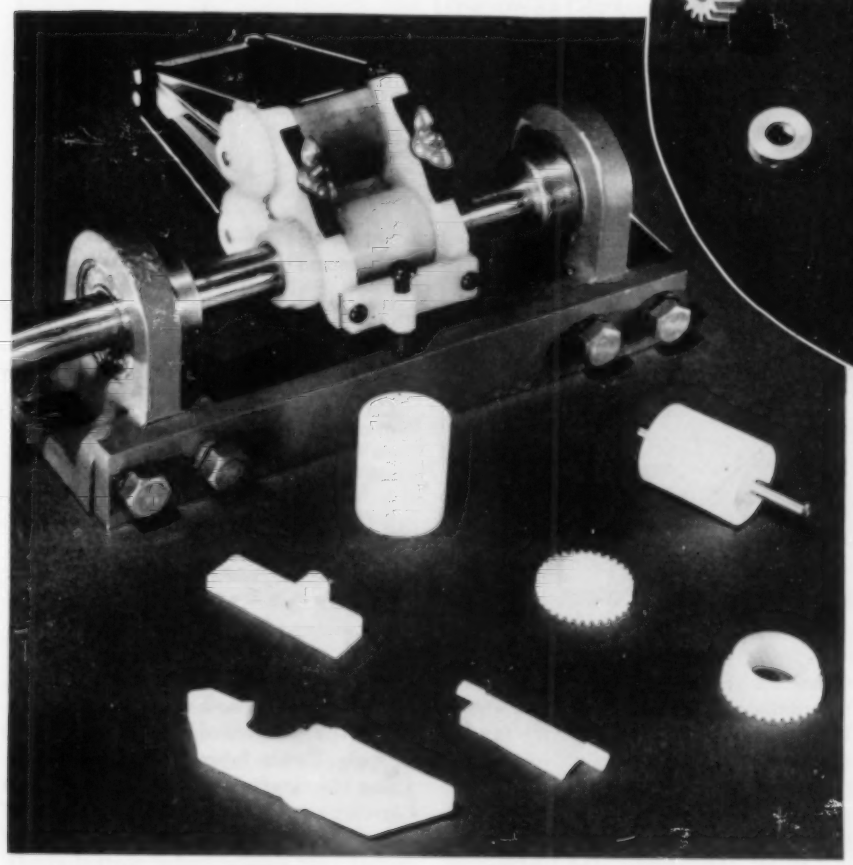
PARTS FOR CAMERAS AND HELICOPTERS

The "innards" of a home movie projector, above, include gears machined from molded blanks of nylon resin. They run quietly without lubrication and outlast those of the material used previously. Nylon bearing cages in helicopter transmissions (left) have a life of up to 2000 flying hours, as compared with 25 hours for the ones they replaced.

FARE COLLECTOR AND COMPONENTS FOR TEXTILE MACHINES

After repeated testing of one type of fare-collection box for buses and trolleys that was under development for nine years molded nylon was selected for 54 different parts, a few of which are shown at the right. The collectors are expected to remain in service for 30 years. Thirteen molded nylon parts are included in a spinning unit (below) for the textile industry. A machine contains about 200 of these units, any one of which may be removed and replaced without stopping operations.





side diameters of cartridge rolls, the working time has been cut to one-twelfth that required by the former hand lapping methods. Nylon belts for polishing glass are being considered, and experiments are being conducted with flat-running belts to edge-up complex carbide-tool shapes. Because the material is resistant to corrosion, well-nigh any type of coolant can be applied during the finishing operation.

Another example of the industrial uses of molded nylon is small-diameter tubing made by the extrusion process for thermistors and serving in place of the conventional phenolic cartridge with metal caps. One glass-enclosed bead type in time-delay circuits is encased in tubing only about ¼ inch in diameter. The heat-resistant property of the material is important in instruments of this kind because the connecting leads extending from both ends of the tube must be flattened under heat and the mechanisms of which a thermistor is a part must operate under a wide range of temperatures.

The durability of nylon is exemplified in still another application. Wire screening was previously measured by means of a counter wheel equipped with different kinds of rubber rims. As the least wear meant short lengths of wire for customers, it was necessary to check the wheel diameter continually. Rubber rims were usable for three weeks at the most, but rims of Zytel-101 tubing made by Polymer Corporation showed no measurable signs of wear after more than six months of service. The same company also provides Atco Electronics Corporation with special-grade strips of Zytel-101 for drawing and forming insulating shells for small-type servomotors. For this work molded nylon offers numerous advantages such as forming without fracturing and therefore fewer rejects during assembly. It not only withstands temperatures up to 221°F but remains stable at higher intermittent temperatures.

Nylon powders are being molded into coil form with success because the strength of the material, even in the case of thin sections, eliminates breakage during the winding operation and its heat resistance permits incorporating terminal blocks or other parts into and soldering lugs onto the form itself. Molded nylon handles on prods used in testing electrical circuits and equipment not only prevent breakage but also serve as insulation.

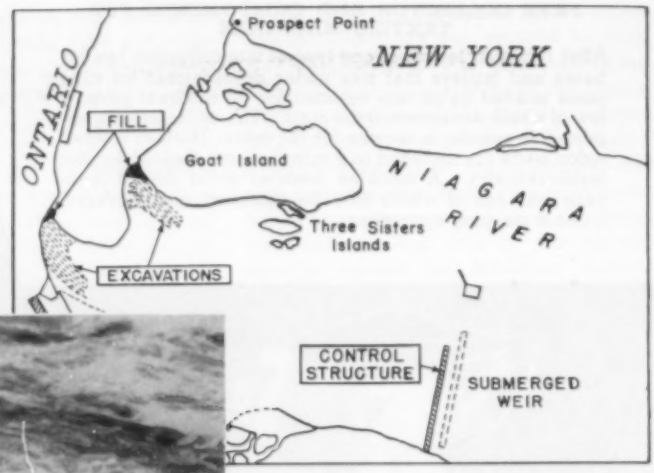
Still other electrical applications include extruded coverings for wire, cable and transmission lines. On one make of airplane are 16 miles of nylon-jacketed low-voltage wire, coaxial cable and transmission lines. In this service, the material offers protection against high-octane gasoline, hydraulic fluids and oil, as well as against abrasion, heat and fungi, aside from savings in weight. Even the miner's lamp has been improved by nylon. Instead of the usual three battery cells, four are housed in a 1-piece case which, together with the insulation between the cells, is of molded nylon. The factor of corrosion resistance enters here, for mine water is notoriously acid.

Among the more complex mechanisms in which nylon plays an important part are the rackless conveyor-type dish-washing machines for commercial or institutional use. The soiled dishes are carried through the washing, rinsing, sterilizing and air-drying processes on an injection-molded belt that incorporates as many as 1300 nylon parts in the small machines and 2500 in the larger ones. The conveyors are designed so that the dishes and glassware do not touch metal, thus avoiding chipping and breakage.

Obviously nylon, the chemical which brought glamor to the fashion world not so long ago, has taken its place in industry as a tough and adaptable material that has proved to be the answer to many problems.

Checking Nature's Errors with

Remedial Works At Niagara



CARVING A RIVER BED

Marked on the map are the three areas where work is being done to halt Nature's alteration of Niagara Falls. In planning it, the engineers have also made sure that the diversion of water for power production will in no way affect the beauty of the famed spectacle. On the contrary, they expect that the grandeur of the cataracts will actually be enhanced. Shown in the left view are two Ingersoll-Rand Wagonjacks and a Jackhamer drilling blastholes and breaking up high ridges of rock on both flanks so the water will flow evenly over Horseshoe Falls and assure an unbroken curtain along the entire 2600-foot crest. The dike is in the background.

ABOUT a million years ago there came to pass the combination of geologic conditions that resulted in the formation of spectacular Niagara Falls. Ever since that time Nature has been modifying her handiwork in the manner of a self-critical sculptor, knocking off a chip of rock here and there. In the last three centuries so much has been removed that the brink of the falls has receded 1300 feet. Engineers believe that the erosion has gone far enough. In the interests of both preserving and enhancing the aesthetic qualities of the falls and utilizing as much of the available energy of the falling water as possible, the United States and Canada have entered upon a remedial program which has been hailed as "conservation in its truest sense."

The entire project entails an expenditure of $17,500,000, which will be shared equally by the two countries. It is a continuation of studies begun as far back as 1905 and of work started in 1942. At that time a submerged weir was constructed to direct more water over the American Falls which was then receiving only 5 percent of the flow.

As the accompanying map of the general area shows, the undertaking is divided into three parts. The first, the building of the Grass Island Pool control structure, will regulate the water level in the Chippawa-Grass Island Pool area, site of new intake works for both Canadian and United States power developments. It is to be located about 1¼ miles above the falls; will extend 1550 feet into the Niagara River from the Canadian shore; and, by means of thirteen sluices, will also indirectly control the amount of water flowing over the brink. By treaty, the volume of the cascade must be at least 100,000 cubic feet per second during the daylight hours of the tourist season and 50,000 cfs at all other times.

The other phases of the project now being carried out involve the excavation and filling in of designated areas near the crest of the falls. This will assure an even flow over the entire length of the brink, thus enhancing the already awe inspiring beauty of the spectacle. In addition it will, in combination with the upstream control structure, halt erosion of the precipice or reduce it to a point where it will be negligible. This article deals with the work that is being done on the Goat Island flank of the Canadian or Horseshoe Falls by the McLain Construction Corporation, of Buffalo, N.Y., under the direction of the U.S. Army Corps of Engineers at a bid price of $595,741.30. It includes diversion of the water normally flowing over the job site; excavation of rock channels; filling in with rock obtained from the area; disposal of excess material to a spoil dump at the upstream end of Goat Island; and the building of stone-faced walls and steps, steel handrails and asphalt sidewalks.

Excavating is now completed and entailed the removal of 36,000 cubic yards of rock. To the layman there was something fascinating about drilling and blasting on the edge of a 162-foot cliff over which a great volume of water rushes continually under normal conditions. So, for the gratification of sidewalk superintendents the contractor provided suitable paths, fenced in for protection, from which they could get an unobstructed view of the operations. As a safety measure, blasting was restricted to the hours between 10 P. M. and 10 A.M. When Terrapin Point has been filled in he will construct permanent walkways and stone walls so that tourists will have better vantage points than ever before from which to watch the falls and the upper cataracts.

Needless to say, the task undertaken by McLain Corporation was fraught with potential hazards, and one of its chief concerns was the safeguarding of men and machines called upon to work in areas generally exposed to the force of tons and tons of tumbling water. The only solution, of course, was to divert the flow by building a diversion dike upstream. Ordinarily, this is a fairly simple matter, but in this case the job was performed without difficulty only because of the unusual construction method followed.

From Little Brother Island, an off-

shoot of the Three Sisters Islands, to the opposite bank of the river were strung steel cables from which was suspended a heavy steel shield or plate at right angles to the stream. The latter was moved along these lines inch by inch out into the river, and in the lee of this bulwark the men and machines built the dike in safety. It was partly because of this procedure that the firm was able to quote the lowest bid on the project. The dike or cofferdam was constructed by driving steel sheet piling and backing it up with heavy rock fill. This was necessary because the structure had to be sufficiently strong to withstand a maximum flow of 320,000 cfs, which is approximately 120,000 greater than the normal flow of the river.

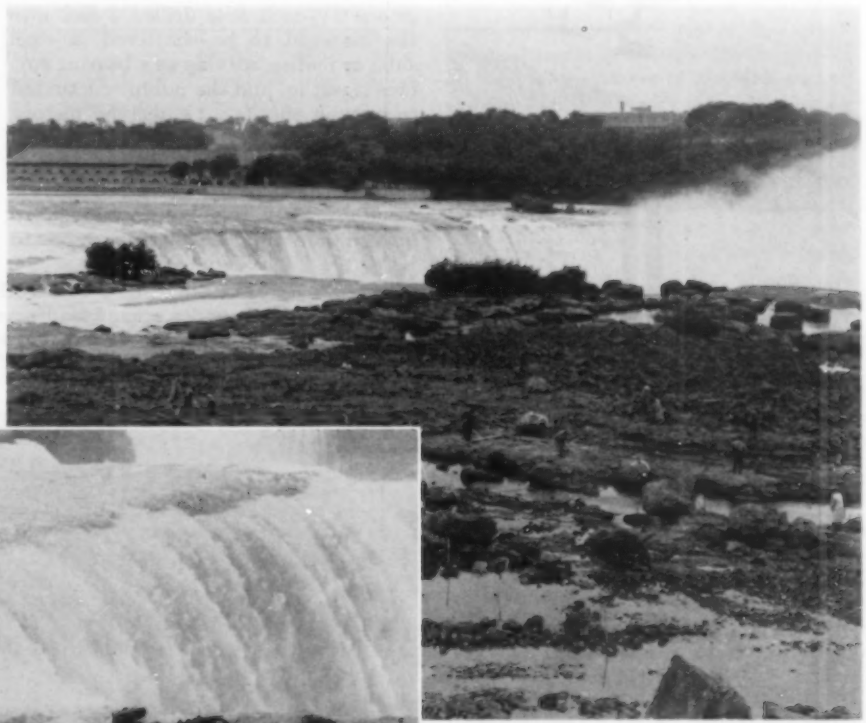
It may be of interest briefly to review the geologic conditions of Niagara Falls. The immediate stream bed is made up of hard Lockport limestone, a formation resistant to erosion by rushing water. But under this bed, which is about 80 feet thick at the rim of the cataract, are layers of much softer material. The latter disintegrates rapidly under the plunging waters, leaving the crest rock unsupported so that large blocks of it break away from time to time and crash into the gorge below. Therein, according to one school of thought, lies the difference between the rates of erosion on the American and the Canadian sides of the falls.

Many of the rock slides on the former shore landed on and were held by a shelf of hard Clinton limestone about at the level of the lower pool, thus forming a buffer which deflected the pounding water from the bluff; the Canadian side has no such protecting glacis. This, plus the fact that an upstream ridge diverts fully 95 percent of the river's flow toward the Canadian shore, accounts for the faster recession of that side and for the horseshoe shape. More even distribution of the water throughout the entire length of the crest and diversion of a large proportion of it for power development have and will cut down the rate of undermining to such an extent that it will be negligible. Before the work described was started, it amounted to around 2.3 feet per year.

When it was decided to do something to slow down Nature's alterations, two hydraulic models of the falls were built, one by Canadian and the other by American engineers. The latter includes the Niagara River upstream to Lake Erie to determine the effects of the remedial efforts, if any, on the upper reaches. The Canadian one, on the other hand, includes only the immediate area and was constructed on a larger scale to facilitate measurement of flow conditions. It was by means of these facilities that the work now being done at Niagara was planned. The models themselves were made possible by the aid of soundings taken from helicopters—the only safe and practical way of observing the brink.

Recent happenings have stressed the need for corrective measures in an alarming way. On July 28 about 187,000 tons of limestone, which had been undermined by seeping waters, tumbled from Prospect Point on the American shore into the gorge below. The rock fall provided an unexpected and unusual job for an FM-3 wagon drill operated by McLain Construction Corporation, as one of the accompanying pictures shows. The machine was used to drill blastholes in the remaining ledge, which had been ruled unsafe by engineers and had to be removed. A month later a second but much smaller slide occurred on the Canadian side, about 7 tons of material breaking away at a point some 200 yards below the falls.

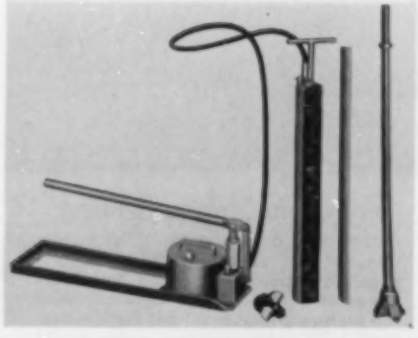
The project underway calls for a large array of the latest in excavating equipment. Space does not allow us to deal with it fully here, but some of it is shown in the accompanying pictures.



ROCK-DRILLING EQUIPMENT

Above is an over-all view of the operations on the American (Goat Island) flank of Horseshoe Falls. Ten Jackhamers were at work in the area when the picture was taken. But for the protective dike just upstream water would rush over the entire area. Shown at the left is an FM-3 wagon drill putting in a row of blastholes to remove an unsightly and unsafe promontory of rock left after the recent 187,000-ton rock fall from Prospect Point on the American bank.

HYDRAULIC ROCK BUSTER



HOW IT OPERATES

The three sketches illustrate the successive steps involved: drilling the hole, placing the Roc-Jak in it and operating its horizontal pistons to break the mass of rock or concrete. The bottom picture shows the hydraulic pump, Roc-Jak, shim and drill steel with detachable bit.

THE invention of rock drills and explosives solved an age-old problem of how to break rock effectively, but modern civilization soon imposed new difficulties by creating various conditions where blasting is hazardous and cannot be employed. In situations like that the shattering of rock or mass concrete is at best a comparatively slow and tedious operation, but in the case of open-face materials it has recently been greatly improved through the development of a simple hydraulic tool that rends them nonexplosively from within.

Called the Roc-Jak, it is a hydraulic jack with ten pistons arranged parallel to one another on one side of and at right angles to the length of a 3x24-inch steel cylinder. Each piston is 1⅝ inches in diameter and has a maximum travel of 1 inch. A small, hand-powered pump develops a pressure of 15,000 psi which, acting on the combined areas of the pistons, results in a cumulative force of more than 150 tons.

In service, the Roc-Jak is inserted into a 3½-inch hole drilled 2 feet into the material to be shattered, a steel shim or feather serving as a bearing surface is put in, and the pump is actuated to expand the Jak. After the pistons are in contact with the shim, an additional piston travel of only ⅛ inch is sufficient to rupture the mass. If the resultant crack is not wide enough to break reinforcing bars, let us say, or to insert a cable sling, then more shims are used. Where the material to be fragmented is more than 6 feet thick, the manufacturer, K. O. Duncan Company, recommends that two or more Jaks be utilized. If it is less than 2 feet (the length of the Roc-Jak) the tool can still be used by blocking off the topmost pistons with steel retaining rings.

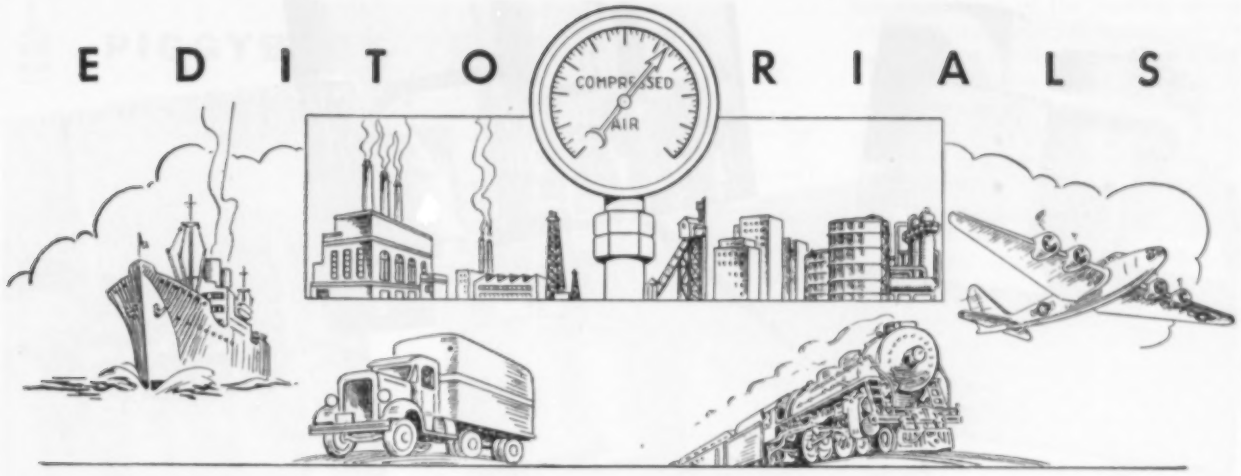
The method is said to be fast and efficient. For example, in concrete the complete cycle of drilling the hole, inserting the Jak and rupturing the solid mass takes only about fifteen minutes. According to the company, it is not unusual for two men with a medium-weight Jackhamer and two Roc-Jaks to break 50 cubic yards of concrete in one 8-hour shift.

Now, as the result of another development, it should be possible to do the work even more expeditiously. Recently, Ingersoll-Rand Company has added to its Carset Jackbit line a 3½-inch bit that is especially well suited for Roc-Jak drilling operations. Because the tungsten carbide-tipped bit does not become dull as quickly as a steel bit and because gauge wear is negligible, drilling time is reduced and the bit will put down many more holes than the three that are customarily obtained with each steel bit. Moreover, it drills a straighter, rounder and more uniform hole, and this is one of the requirements for successful Roc-Jak performance.

REMOVING POWERHOUSE FOUNDATION

The Roc-Jak provides a quick and economical means of demolishing open-face ledge rock or mass concrete in locations where explosives or a drop ball cannot be used. An instance of this kind was the removal of 2500 cubic yards of concrete from inside a powerhouse at Ajo, Ariz., as pictured below.

EDITORIALS



PENCILS PLEASE

A DECIDEDLY novel idea for helping underprivileged children get started on the road to an education has come to our attention and we gladly give it space here. People are requested only to gather up the surplus pencils that they probably have around homes and offices and send them to Pencils Please, 1721 Park Avenue, New York 35, N.Y.

Strange as it may seem, tree twigs, lumps of coal and lime are still being used to write with in backward parts of the world, including some areas in America. Salom Rizk, now a successful writer and lecturer, received his first pencil when he was a lad of thirteen in his native Syria. It was a 4-inch stub from America. Prior to that time he had been writing in soft earth with a finger.

The pencil and others that followed it so impressed him that he resolved to come to this land of opportunity as soon as possible. He was able to do so, and found success and happiness here. He is the moving spirit behind the appeal for pencils, which is implemented by the Save the Children Federation, a nonprofit, nonsectarian organization that lists numerous prominent people among its sponsors.

OUT TO PASTURE

MEN and draft animals both get a better break in old age than they used to. The internal-combustion engine has emancipated the horse on farms and construction jobs and motorized equipment has sidelined even the celebrated Army mule. In some countries, of course, burros, oxen and other 4-legged burden bearers still labor hard, but time will change their status too.

Half a century ago, only a small fraction of the men past 65 could take things easy. Few were able to save enough to be independent or to make investments that insured them a leisurely old age. Many of the poor who became too infirm to earn a living wound up as public charges in homes for the aged; others were lucky enough to be taken care of by their children or other relatives.

Now all this has changed. Both industry and state and federal governments are continually liberalizing their provisions for life after 65. Consequently, old age is not so fearsome to contemplate as it once was. A tour of Florida or Southern California in the wintertime will reveal hundreds of thousands of happy, carefree elderly people who never could have reached that status under the old order of things.

Industry now must spend roughly $11,000 per worker to provide the necessary capital for plant, tools and supplies to produce goods. As industry becomes more highly developed the necessary capital investment per worker will increase.

We are prone to think of industrial pension plans as strictly recent developments, but not all of them are new. For example, Joseph Durr, who just retired after 50 years of service in Du Pont's Deepwater, N.J., plant, was covered by a pension provision throughout that long period. Du Pont adopted a formal pension plan in September, 1904, and even before then had an informal one. Nearly 8000 of its former workers now get monthly checks, and others are retiring at a rate of 50 per month. Less than a dozen firms had formal retirement programs in force in 1904, whereas 22,000 have now safeguarded the futures of their twelve million employees. Millions more are, of course, eligible for social-security benefits.

Our system of government not only provides earners with the highest pay the world has ever known, but also manages to set aside enough to turn them "out to pasture" in the twilight of life. Those few who profess to favor a different form of rule would do well to ponder these facts.

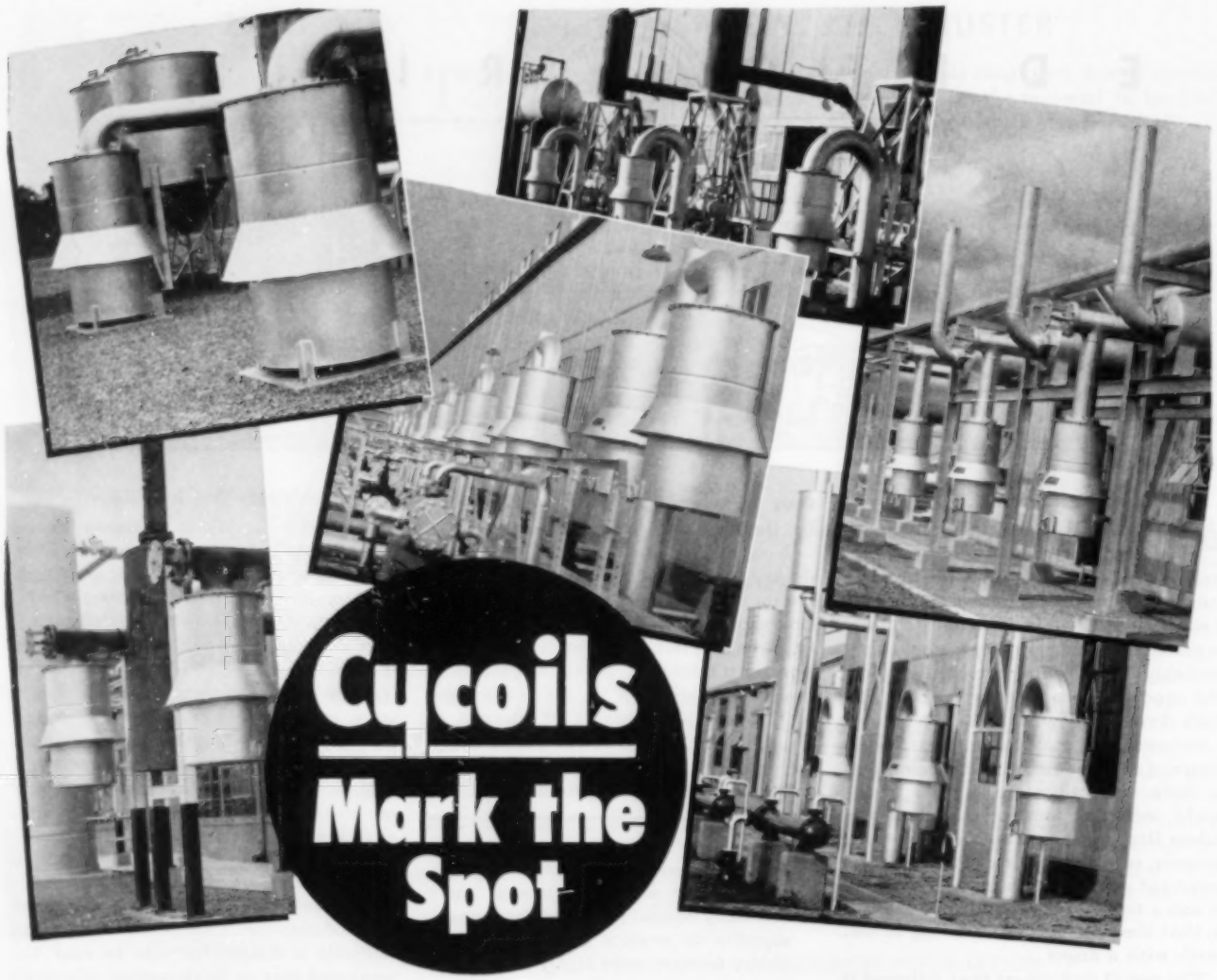
SAVING THE BOSSES

IN MOST American business establishments nobody works harder than the bosses. Lesser paid men still look with envy upon the executives above them, but there is a growing realization that the big jobs aren't the soft snaps the uninformed have always thought them to be. Proof that those who direct large enterprises are under too much physical strain is found in the increasing and alarming number of breakdowns and sudden deaths in their ranks. These men are usually above average in stamina, else they wouldn't have got ahead, yet too many of them have their careers snapped off as the result of overwork.

Dr. Walter Woodward, a psychiatrist with American Cyanamid Company, suggests a simple formula to ease the wear and tear on businessmen who push themselves beyond the limits of their powers of concentration. It works like the "coffee break" common among plant and office workers, except that the executive isn't necessarily expected to leave his desk or to indulge in refreshments. He is advised merely to interrupt at fairly regular intervals whatever he is doing—in effect, to change his pace.

Doctor Woodward says the average corporation tycoon can concentrate on what he is doing for about two hours before his attention wanders. It then takes him a while to get his mental gears back in mesh. Meanwhile he is apt to fret over the slowdown, and that isn't good for him. The doctor's prescription is a deliberate 10-minute "brain recess" every hour. He tells American bosses that if they will turn to something else —preferably something less exacting— after 50 minutes of close application they will be able to work for four hours before getting tired.

For untold years, it has been a tradition of underground metal miners to "take five" whenever they are tired or the going gets tough. For heavy brain-workers the admonition now seems to be: "Fifty and ten and back to work then."



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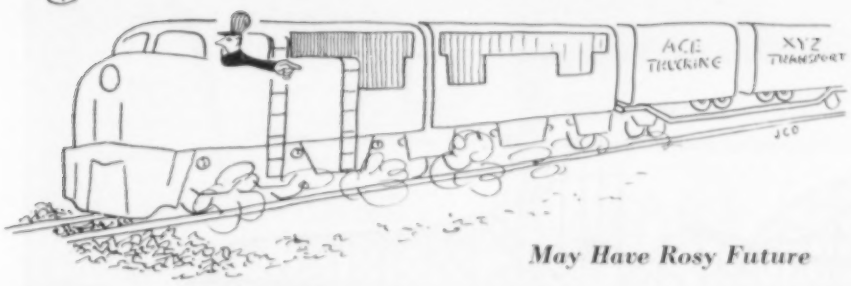
PIGGYBACK TRANSPORT



May Have Rosy Future

THE old admonition "If you can't lick 'em, jine 'em" seems to have penetrated the thinking caps of both the railroad and trucking industries, for piggybacking, which has met with slow acceptance for nearly three decades, is fast becoming the newest consideration of the major carriers.

Since the end of World War II railroads have invested more than $6½ billion in new equipment and facilities, but over-all freight tonnages have increased an average of only 3.6 percent annually since 1946 and less-than-carload shipments have steadily declined. Trucking lines during the same period have experienced huge increases in the volume of long-distance haulage, with subsequent mounting revenues. But the other side of the coin indicates rapidly rising insurance costs and operating difficulties engendered by varying individual state laws governing weight and by the nation's congested highway system.

Piggybacking, for those who are not familiar with the term, is the practice of carrying long-haul, over-the-road trailer units on specially built flatbed railroad cars from one established terminal point to another. The advantages of this happy compromise are manifold. Trucking lines that avail themselves of this service are able to save labor costs because drivers are not needed for the rail trips except to move trailers from points of origin to terminals and from terminals to their destinations. It should also effect appreciable economies through greatly reduced tire and fuel consumption. Furthermore, full use of space in trailers is possible because the conflicting over-the-road weight limitations do not enter into the picture. Savings thus accumulated, plus others not yet anticipated, will more than pay the fees imposed by railways which, in turn, will benefit by the increased use of their facilities. The speed and dependability of railroads, no matter what the weather, are factors to be considered as well.

While it was announced in July that the Interstate Commerce Commission had approved the piggybacking programs of four eastern roads, the idea is much older than many people realize. As far back as 1926, *Electric Railway Journal* and *Electric Traction* reported to their readers that the Chicago North Shore & Milwaukee was carrying out plans for a piggyback service. Even then it was believed that savings for truckers and increased revenues for railroads would be the outcome of transporting trailers on especially built flatbed cars.

At that time motor trucks began to haul trailers with 7x17-foot metal bodies and a capacity of 8 tons each to a central loading station. There they were shunted by means of special runways onto flatbed cars on which they were held firmly in place during transit by locking devices, two to each car. To adapt ordinary flatcars for "merchandise-dispatch" service it was necessary to lower the beds 4 inches so that there would be ample overhead clearance for the trailers along the entire right of way. This, in turn, made it necessary to cut out the ends of the cars so as to permit free movement of the radial drawbar and coupler and resulted in bolting a steel casting plate on to the end to serve both as reinforcement and as support for the coupler. Chicago North Shore & Milwaukee reports for 1927-28 indicate that the operation was successful.

In 1933 schedules were filed by the St. Louis, Southwestern Railway Company proposing rates for hauling loaded or empty vehicles on flatcars between St. Louis and points in Arkansas and Louisiana. The service and rates were in the nature of an experiment to determine whether they could be counted on to help the road meet the competition of unregulated motor-freight carriers. This facility became a permanent part of the system's operations.

In 1938 the New York, New Haven & Hartford Railroad inaugurated a trailer-transport service with terminals in New York City and Boston, Mass., thus making it possible to remove much truck traffic from the congested highways of the lower New England States. The following year piggybacking was extended to include a terminal in highly industrialized Providence, R. I. By 1951, regular schedules between New York and Springfield, Mass., New Haven, Conn., and Boston, New Haven and Providence were an accomplished fact. At that time 22 motor carriers and shippers were availing themselves of the hauling system, which offered transport during peak periods for 1400 to 2000 trailers per month.

In the postwar years many of the country's major railroads developed piggybacking divisions, which have greatly increased revenues. It is an accepted fact that ultimate success of such a venture depends upon the use of railroad equipment adequate to insure efficient, dependable service; maintenance of schedules which are better than those of over-the-road carriers; and the establishment of attractive rates.

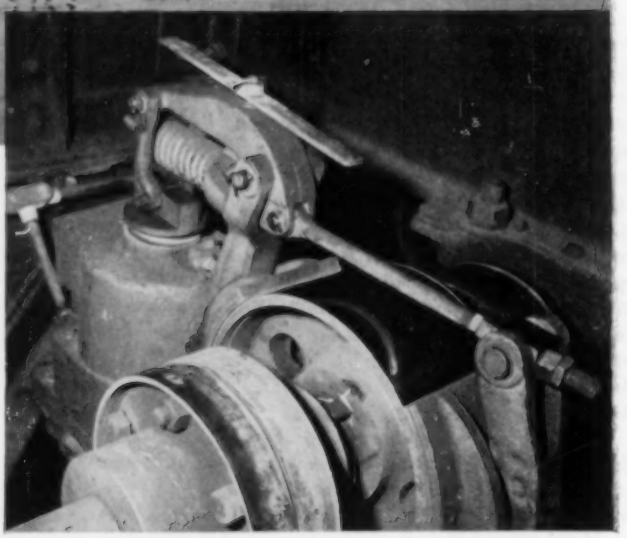
The mechanical problems involved in coördinating a rail-truck service necessitate designing flatcars capable of handling two trailers; meeting clearance requirements on all sides along the railroad right of way; providing devices for efficient and rapid loading and unloading of the units; and laying out special piggyback terminals. General Motors has put in production a 75-foot trailer-transport car (ordinary boxcars are 40 feet in length) on which two standard semitrailers up to 35 feet long can be side-loaded from an elevated platform or from a depressed track. A fifth wheel arrangement embodied in stanchions at the ends of the car engage the kingpins of the trailers. Each unit is tied down to the flatbed by means of a pair of adjustable struts, one on each side and adjacent to the wheels. The struts also are of aid in controlling the vehicle's side roll. Running the length of the car's depressed center is a raised section which strengthens the structure and prevents side movement of a trailer should its tiedown devices fail to function properly. General Motors cars, as well as those of other manufacturers, may be leased or purchased.

Forklift trucks are being used to load transport cars. Especially designed for the purpose and called Trailoaders, they have an arrangement that permits lifting a trailer after it has been spotted on the car and setting the kingpin in the stanchion. These trucks have done away with the old-style "circus-loading" technique, which limits the amount of work that can be accomplished in a given time because it is done by means of a ramp placed at the end of each car.

Production of other equipment for this field of transportation has also grown amazingly. Among the things designed for piggybackers' needs is a portable magnesium ramp that is said to be light enough for "a couple of girls to push around" and strong enough to support the weight of a fully loaded trailer. These ramps serve in place of loading docks and make for a more flexible terminal yard.

In this "marriage of convenience," railroads and trucking outfits have an opportunity to strengthen the economic status of the freight-transport industry, with benefits to all concerned.

DULUTH-SUPERIOR BRIDGE opens from 15 to 50 times daily in the iron ore shipping season to let ore boats through. Wiring for lighting, protected by 1500 feet of Everdur Electrical Conduit, is installed under the deck.



HERE EVERDUR CONDUIT protects wiring to electric brakes on bridge motor. It is also used for power lines to emergency generator, and on lines serving strip heaters in power house.

Everdur passes long test on Duluth-Superior span

One job Everdur* Electrical Conduit does on the Duluth-Superior Bridge is protect electric light lines. Heavy rain and snow driven by 60 to 70 mile-an-hour winds often pound at this conduit. Heat and cold do their worst. It is exposed to acid fumes from ore boats and rail traffic. Vibration from opening and closing of the bridge, and constant traffic, is a daily threat. Yet recent inspection shows the Everdur Rigid Conduit still in excellent condition. Not a sign of wear, rust or corrosion!

Everdur Electrical Conduit is made of Everdur Copper-Silicon Alloy in two wall thicknesses (R.C. and E.M.T.). For additional information about this Anaconda Product, write to: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

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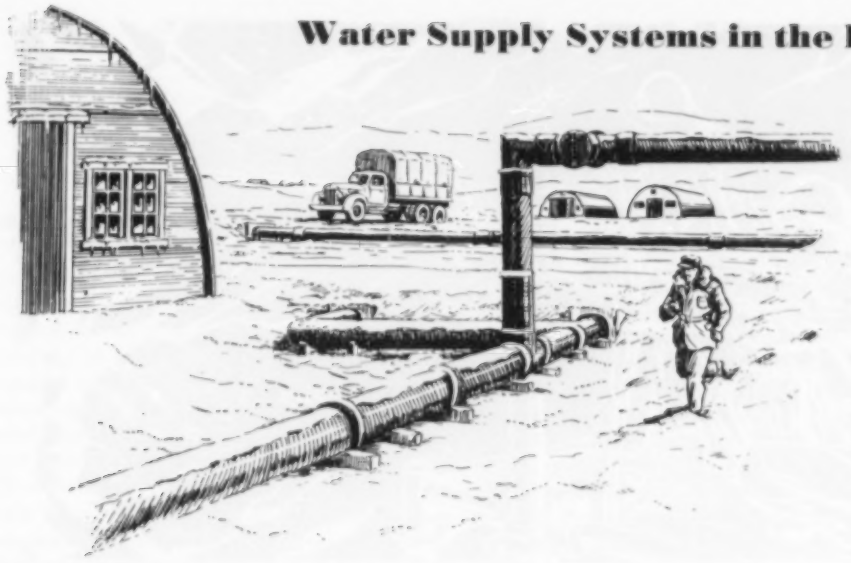
Water Supply Systems in the Frigid North



INSULATED SURFACE LINES AT THULE, GREENLAND, AIR BASE

IN THE cold latitudes of the Northern Hemisphere engineers have been called upon to provide water-supply systems for industrial and domestic uses that will function dependably despite the most severe winter weather. Permafrost and generally rocky terrain, which are peculiar to glacial regions and once made the task difficult of accomplishment, have ceased to be obstacles.

In the mining town of Flin Flon, just north of the 54th parallel in the Province of Manitoba, Canada, the water mains have never been known to freeze even though most of the distribution network is aboveground and temperatures often drop to minus 40°F. Cliff Lake, more than 3 miles from the community, is the source of supply and furnishes water of such good quality that the only treatment required is chlorination. From there the water is pumped through a wood-stave pipe line, 13,200 feet long and 20 inches in diameter, and delivered into a reservoir formed by the natural contours of the land and by three man-made dams. This storage basin has a capacity of 76 million gallons in summer and 39 million in winter, the decrease being attributable to the formation of ice as much as 2½ feet thick at times.

The reservoir and pumping plant on the lake shore are owned and maintained by Hudson Bay Mining & Smelting Company Limited, which was formed to work the rich copper-gold-silver-zinc ore body that has become the famous Flin Flon Mine. Water for the mining and smelting operations and to serve the town is conveyed variously through a rock tunnel, as much as 30 feet underground in places, through lines in trenches or resting on the rocky surface or on trestles where uneven terrain or muskeg is encountered. According to R. F. Comstock, town engineer, mains aboveground and those buried less than 3 feet deep are run through cedar boxes about 3x2 feet in section. Any deeper than that are backfilled with earth.

The entire distribution system is laid out with supply and return mains from which service lines extend into every household or property. Each wooden casing therefore contains two water mains and the sewer pipe. These are laid side by side and insulated with wood shavings. The supply system taps the high-pressure header of the circulating pumps, which take suction from the header into which the return mains discharge. Thus, it is possible to circulate the water not only through all the mains but also the service connections to combat freezing. But that alone would not suffice to keep the lines open the year round. It should be added here that at the point where the supply and return service pipes come together at the far end there is an orifice with two small holes that restrict circulation to the volume needed. Without this arrangement the pumps would not be capable of maintaining the differential pressure between the supply and return mains.

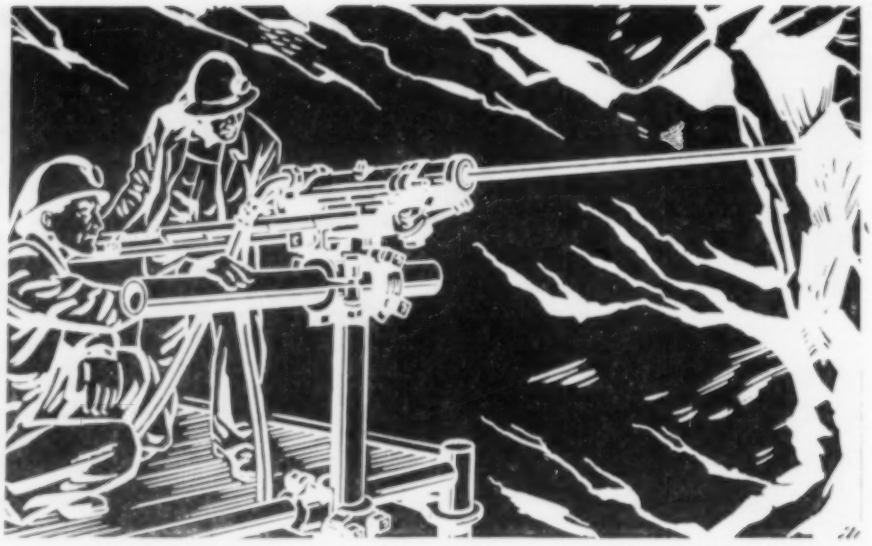
When cold weather sets in, the water passes through heat exchangers before entering the distribution network to raise its temperature enough so that it will still be well above the freezing point on the return trip. Heat for the economizers is generated by oil-fired steam boilers in two plants; one located alongside the 2½-mile wood-stave pipe line and the other adjacent to the town pump house. "It has been our experience," states Mr. Comstock, "that while insulation of pipes and heating the water are useful and to some extent necessary, the critical points are having sufficient circulation on the water mains and good grades."

Just above the 60th parallel at Yellowknife, on Great Slave Lake in the North West Territories of Canada, mining activities called for the installation of a water-supply system. In that region the soil, except for the upper 10 feet or less, remains frozen even in the summertime and the mean annual temperature is around 22°F. There, like at Flin Flon, the water, which is taken from the lake, is pumped through insulated pipes, is chlorinated, heated and circulated through supply and return mains and similar house connections. The cast-iron pipes are laid alongside each other underground, have a minimum cover of 5½ feet and are protected by tightly compacted moss 1 foot thick at the top and sides and 2 inches at the bottom. Normally, the water is heated from November to the beginning of June and enters the distribution lines at 41°F. During March, when some 80 percent of the outgoing water is recirculated, the return-flow temperature is generally 40°.

When major breaks occur through frost action they are generally repaired without service interruption. However, excavating with pneumatic tools takes approximately two weeks per opening because of the hardness of the ground. The use of explosives is prohibited on account of the proximity of the mains, and holes cannot be backfilled with earth until thaw sets in. Fire hydrants in the system, which are of the dry barrel type, are inspected twice a week and alcohol is applied to caps, packing, etc. Freeze-up at the bottom of a water plug through any interruption in circulation is infrequent and is taken care of by putting a fire pot in the manhole box and letting it remain there overnight. Aboveground, thawing is done with blowtorches. It is reported that none of the 142 service connections, which lie at an average depth of 5 feet, has been frozen under normal operating conditions.

Fort Smith, about 175 miles south of Yellowknife, also depends upon preheating to maintain year-round service but uses bleeders at dead ends. The community pumps its supply from the Slave River, on which it is situated, and delivers the water through two intakes, drilled horizontally through 40 feet of solid rock, to a treatment plant where alum and soda ash are added. After filtering and chlorination, it is stored in a reservoir under the pumping station, heated and distributed from a pressure tank. The mains are made up of Johns-Manville Transite (cement and asbestos) pipe laid at an average depth of 10 feet. The minimum for house connections is 8 feet, where they are normally safe from freezing. In the month of January, for example, the water left the pump house at a temperature of 42°F and reached the end of the line at 35°, or safely above the freezing point.

5 tunneling records set



with Ingersoll-Rand Drills Utilizing Nickel Alloy Steels

Even under conditions generally conceded to be among the most severe encountered by any type of machinery, five major records for fast tunneling were set with one type of drill...

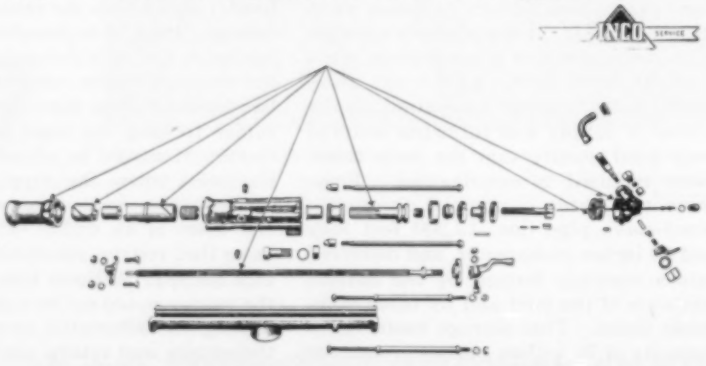
The Ingersoll-Rand DA 35's and their successors, the DB 35's.

This performance attests not only to excellent design but to the stamina of steel specified by I-R engineers and metallurgists.

To assure utmost dependability, I-R uses nickel alloy steels for fronthead, backhead, rifle bar, valve chest, chuck and chuck jaw of the drill itself. Also, for the drill steel centralizers, feed screw and feed nut of the mounting shells.

Every one of these components stands up to repeated impacts, wear and abrasion, because the nickel steels from which they are fabricated combine inherent strength, toughness and hardness.

Your requirements in a steel may be altogether different. But remember, there are many standard grades of nickel alloyed steel available. This allows you to select one with the best combination of properties for virtually any fabrication and service demands. Send us details of your problem for our suggestions.



Nickel Alloy Steel Parts of Ingersoll-Rand DB 35 Drill

Major Tunneling Records

Name	Date	Size of Bore	Advance
Carlton-Cripple Creek (Colorado)	1940	10′x11′	1879′ (1 month)
Owens Gorge (California)	1949	11½′-12¼′ dia.	2442′ (1 month)
Big Creek No. 4 (California)	1950	24′ dia.	222′ 1 week)
Tahtsa-Kemano (British Columbia)	1952	25′ dia.	1073′ (26 days)
Gateway Tunnel (Weber Basin, Utah)	1953	11′ horseshoe	1350′ (24⅓ days)

Five Modern Tunnels... Notable for the Speed at which they were holed through

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

Circle 18A on reply card

This and That

Sandblast Wrong House

Nobody was home at the residence of Mrs. Mary Cuniff in Philadelphia, Pa., on the afternoon of September 2. Her daughter was at work and Mrs. Cuniff had gone shopping. It was a warm day, so several windows were left open. When the daughter returned around 5 P.M. strange things were happening. A truck carrying an air compressor was parked in the street and hoses ran from it to two men who were sandblasting the brickwork of the 2-story house. They had plainly been at it all afternoon. When questioned, they said they had been sent there by their employer, a contractor. A telephone call disclosed that there had been a mixup in addresses. Mrs. Cuniff lives at 431 South Fiftieth Street. The men, it developed, were supposed to go to the same number on North Fiftieth Street. Mrs. Cuniff didn't want her house cleaned; neither was she happy about the sand that the breeze had wafted into it through the open windows. The contractor hastened to make amends.

★ ★ ★

Conestoga Wagon Observance

Long overdue attention was paid last month to the Conestoga wagon, famous old land frigate that was 100 years old when the prairie schooner or covered wagon patterned after it came into prominence during the California gold rush. A committee from Lancaster County, Pa., where the Conestoga originated, organized a Conestoga '54 program and arranged a 350-mile overland trip from Lancaster to Wheeling, W. Va., by an authentic 130-year old model of the famous wagon drawn by six trained and pedigreed Belgian mares.

The journey, which was made in three weeks at an average pace of 3 to 4 miles per hour, was sponsored by the Mail Pouch Tobacco Company, which has its main office in Wheeling. The concern was founded in the last century by two brothers named Bloch, who observed Conestoga wagon teamsters rolling inexpensive cigars from Lancaster leaf tobacco that they were transporting. The brothers began making "stogies," a word derived from Conestoga.

The Conestoga wagon was conceived by unrecorded farmers along Conestoga Creek. Unlike the covered wagon that came later, it was designed strictly as a freight carrier. Farmers needed something that could deliver their produce to markets over the roughest roads, and it is believed that local carpenters, wheelwrights and blacksmiths combined to build a suitable vehicle from local wood and iron. Without its load, one of them weighed 3500 pounds. The wagon bed was 16 feet long and wide enough to accommodate a hogshead or two flour barrels side by side. To prevent the freight from shifting forward or backward on steep grades, the bed dipped from each end towards the center like a boat. The rear wheels were 5 to 6 feet high and had tires, sometimes almost a foot wide, that could negotiate soft ground without sinking in too deep. Without its top, the vehicle resembled a dory on wheels.

The white, hempen covering dipped in the center and flared out at the ends. It was stretched over a dozen hickory arches fixed in sockets and was lashed down at the sides and drawn together at the ends to protect the cargo. The front and rear peaks were 11 feet above the ground. Midway of the left side was a toolbox with ornamental iron hinges, and just above it a "lazy board" that pulled out like a shelf on which the driver could ride sitting or standing. More

often he rode the nigh or left-wheel horse. Across the rear end hung the feedbox, which could be detached and suspended from a pole to put it within easy reach of the horses after they had been unhitched.

The Conestoga hauled loads of from 4 to 6 tons and was normally drawn by six horses, although four and eight were used at times. A breed of draft animals known as the Conestoga, one of only four strains originated in this country, was developed from Belgian "drays" to pull the vehicles. A typical animal stood 16½ to 17½ hands (66 to 70 inches) high and weighed around 1600 pounds. It was usually black, but from mixed breeding came bays, dapple grays and some sorrels. The wheel horses, which had to do the backing and turning, were the heaviest pair. A wagon with a span of six stretched out for 60 feet.

Conestogas played a vital part in some chapters of American history. Benjamin Franklin bought them by the hundreds for use in the Revolutionary War, and they came into the news in June, 1775, when General Braddock departed with 150 of them on his ill-starred expedition against Fort Duquesne which the French had built on the future site of Pittsburgh. Franklin provided them after Braddock's agents had scoured the backwoods of Virginia and Maryland without finding suitable vehicles. They carried gunpowder from Wilmington, Del., to Lake Erie in 1813 to help win a decisive battle.

The early wagons had bodies painted a bright Prussian blue, and the running gear was a vermilion red. These colors, along with the white of the canvas top, may have inspired the chromatic combination of the American flag, which was not created until 25 years after the Conestoga became a familiar sight. Scholars from Lancaster County who have been digging into the flag's origin say the Betsy Ross legend may be fiction. They point out that it has been deleted from the Government's circular on the national emblem and also from *The Americanism Manual* published by the American Legion. There is said to be proof that the story crediting Betsy Ross with having originated the flag was first published 34 years after her death.

★ ★ ★

To Move Steamship Inland

A New York construction firm has the unusual job of moving a retired excursion steamer 2 miles overland to a permanent dry-land resting place. This fall, Merritt-Chapman & Scott Corporation will take the *Ticonderoga*, last of the New England sidewheelers, out of Lake Champlain at Shelburne Point, Vt., and deliver her to the Shelburne Museum where she will be berthed on the lawn among a lighthouse, a meeting house, a reconstructed colonial church, a restored covered bridge and other New England structures of bygone days. The location is 5 miles south of Burlington, Vermont's largest city.

The 700-ton, 60-foot-wide vessel will be run into a basin that is being excavated in the lake shore and will be dewatered to lower the craft onto a cradle mounted on trucks resting on two railroad tracks spaced 20 feet apart. A motor winch will pull the load along a stretch of several hundred feet, and when it reaches railhead the tracks will be picked up and laid ahead for another run. The route will cross cornfields, pastures, two highways, a brook and the Rutland Railroad. At the end of the final "voyage" the steamer will be jacked off the trucks onto a permanent concrete-and-steel foundation.

Last September the *Ticonderoga*, a 1200-passenger coal-burning ship, completed 48 years of service during which time she carried more than a million passengers and traveled a distance equal to 50 trips around the world. She has an elaborate dining saloon which is to serve as a restaurant for the museum.

No Leakage No Lubrication

That's why Ingersoll-Rand's advanced design

DMV and **DHV PUMPS**

can end your maintenance problems in general hydraulic service

SINGLE-STAGE
DOUBLE-SUCTION
HEADS TO 340 FT.
CAPACITIES TO 2100 GPM
TEMPERATURES TO 200°F.

- **Extra Protection Against Shaft Leakage** through use of efficient *double* shaft seals in place of usual, packed stuffing boxes.
- **Double Shaft Seals** end stuffing box maintenance.
- **Longer Seal Life** assured with *double* shaft seals. Clean sealing water is injected to protect sealing surfaces when pumping gritty liquids.
- **Sealed, Cartridge-Type Bearings** require no lubrication throughout their service life.

These advanced design features make the DMV line the simplest and most maintenance-free single-stage double-suction pumps ever developed by Ingersoll-Rand for general hydraulic service. Ask your nearest I-R representative for complete information on this latest pumping development.

Ingersoll-Rand
Cameron Pump Division
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COMPRESSORS • PUMPS • AIR & ELECTRIC TOOLS • ROCK DRILLS
VACUUM EQUIPMENT • CONDENSERS • GAS & DIESEL ENGINES

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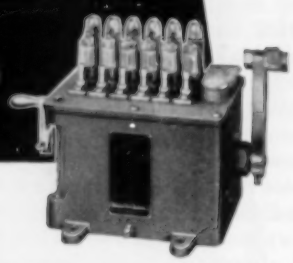
For Positive Automatic Machine Lubrication use

HILLS-McCANNA

FORCE FEED LUBRICATORS



● Hills-McCanna Force Feed Lubricators are specially designed oil line pumps that provide a positive automatic flow of oil to even the most difficult-to-lubricate spots. Available in open or enclosed types in sizes from 2 to 32 pints with 1 to 48 feeds. Oil flow through the lubricator is exactly controllable to meet your specifications. For complete information, write for catalog L-52. Hills-McCanna Co.—2361 W. Nelson St., Chicago 18, Ill.

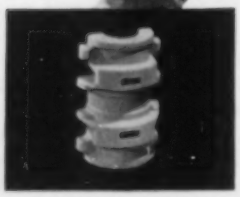
HILLS-McCANNA

force feed lubricators

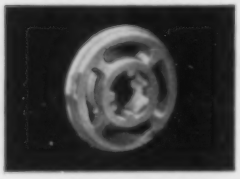
Also manufacturers of Saunders patent valves • chemical proportioning pumps • magnesium alloy sand castings.

Circle 20A on reply card

BEARIUM METAL superiority proved in over 25 years of "on-the-job" service in scores of varied applications.



Special castings made to customer's specifications.



Wherever there is a bearing application involving high speeds, poor lubrication, heat-generating loads, elevated temperatures, dusty and gritty surroundings—or where a liquid other than oil is used as a lubricant—there you will find the ideal application for BEARIUM METAL. For it is under adverse operating conditions such as these that BEARIUM METAL out-performs all other types of bearing materials . . . by prolonging bearing life, preventing shaft seizure and scoring. In short, it does a more efficient job longer at lower operating cost.

We'll be glad to send you the complete story on BEARIUM METAL, so write TODAY!

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Circle 21A on reply card

HOW TO GET BETTER COMPRESSED AIR DRAINAGE!

USE THE RIGHT TYPE TRAP FOR THE JOB!

TYPE OF TRAP	SNAP ACTION (Fig. 1)	REGULAR BALL FLOAT (Fig. 2)	INVERTED BUCKET (Fig. 3)
Handles oil?	Light oil only	No	Very well
Handles dirt?	Moderate	No	Very well
Air loss?	None	None	Small
Requires priming?	No	No	Yes
Float collapse or leakage?	Remote	Remote	Impossible
Gravity drainage to trap required?	Yes	Yes	No

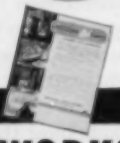
FIG. 1

FIG. 2

FIG. 3

GET THE FACTS:

FREE AIR TRAP BULLETIN *Send Today*



ARMSTRONG MACHINE WORKS

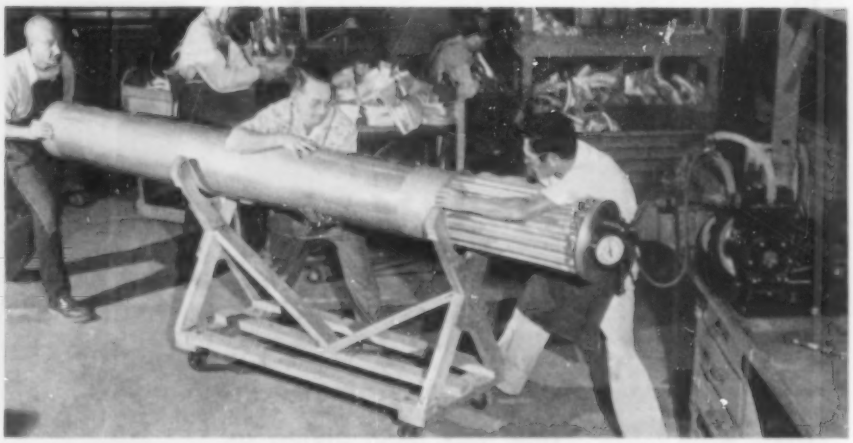
885 Maple Street, Three Rivers, Mich.

Circle 22A on reply card

Pipe Shrunk to Go in Smaller One

LADIES who put No. 5 feet into No. 4 shoes may have inspired engineers of the Solar Aircraft Company, San Diego, Calif., to work out a method of sliding a 10-foot-long metal tube 12 inches in diameter over one that is half an inch larger. The shoehorn in this case is vacuum. The inner tube is corrugated lengthwise, and by closing the ends and exhausting virtually all the air it is contracted to about 11 5/8 inches so the other one can be slipped over it.

The two tubes are components of an augmentor for a Convair-Liner 240. The finished piece, having a large bell mouth at one end and a long nozzle at the other, is about 16 feet long. It conducts exhaust gases backward from the engine manifold. This flow induces air to enter the bell and to help cool the engine. Expulsion of the gas and air from the nozzle creates a jet effect that gives the plane a forward thrust and increases its speed. Meanwhile, some of the air drawn in and heated by the engine passes through a heat exchanger. This has a dual benefit: cooling the augmentor and warming air for heating the cabin and de-icing the plane's leading edges.

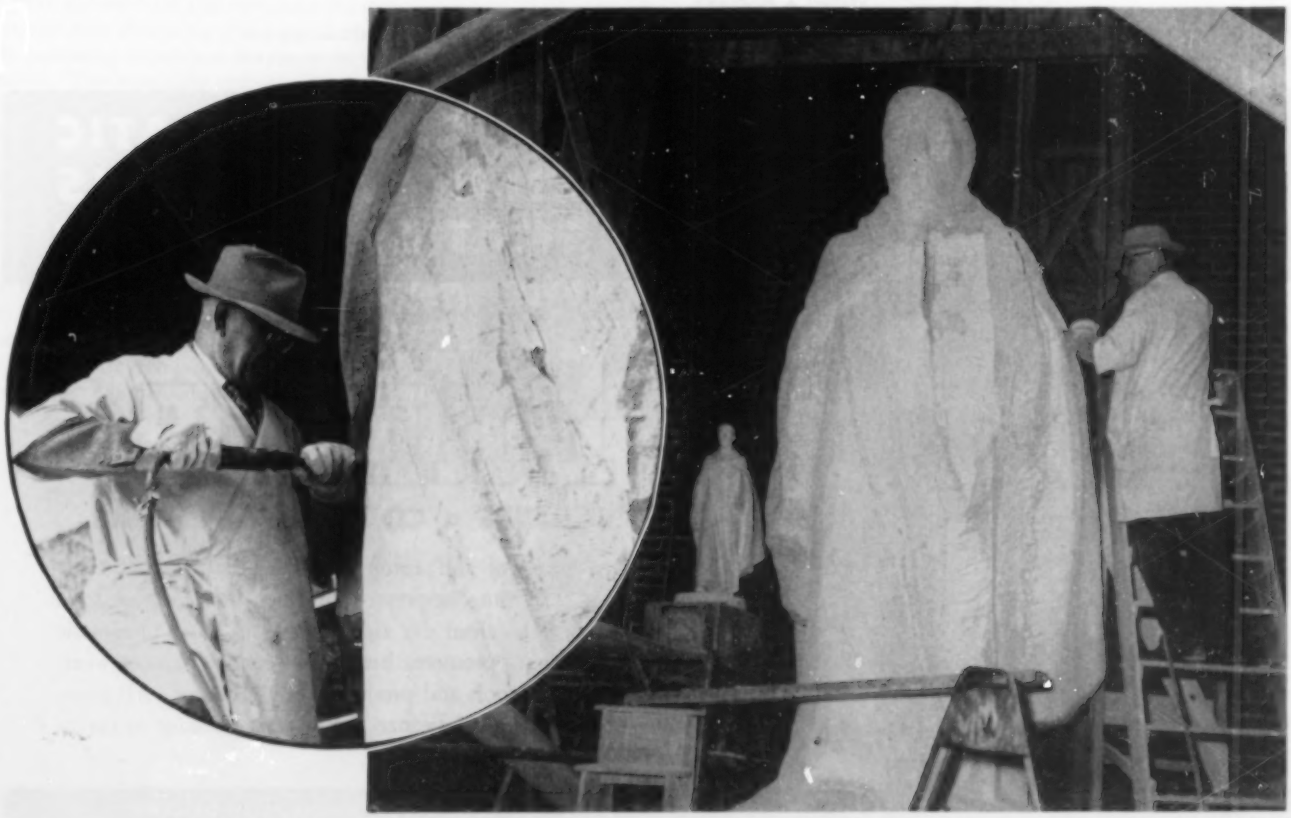


EVEN A LAUNDRY COULDN'T DO THIS

While a vacuum pump shrinks the inner 12½-inch pipe by exhausting the contained air, the outer 12-inch shroud is pushed and pulled over it.

By the first assembly method tried the outer tube was pulled over the inner one with a pulley and winch while both were immersed in water. This was sometimes successful, but more often the units were damaged through galling and scratching. One day an engineer conceived the vacuum-shrinking idea, and it was tested with good results. As the work is now done, a maple fixture, with slats that fit into the several corrugations, is put into the tube to prevent it from collapsing. It is then sealed with rubber-covered metal ends, one of which has a hose connection that is attached to a vacuum pump.

When the air has been exhausted down to a pressure reading of 3 inches of mercury, the inside tube contracts sufficiently to allow the outer one to be pushed over it. The vacuum is then released and positive air pressure applied to expand the inner tube to a snug fit against the enveloping one.



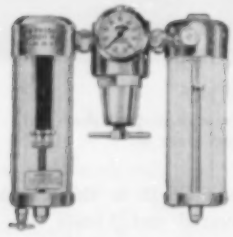
PHOTO, EARL MINSER

ST. BERNARD OF CLARBOUX

Shown here is a chunk of Indiana limestone taking shape under the skillful hands of Prof. Christian Petersen, sculptor-in-residence at Iowa State College, located at Ames. The stone originally weighed 20 tons, and approximately 8 tons will be removed chip by chip by aid of an air-operated chisel to complete the huge statute, a model of which stands in the center. Tools of this type have replaced the chisel and mallet and taken much of the hard work out of sculpturing. The statue is destined for St. Bernard Roman Catholic Seminary at Dubuque, Iowa.

Prominent User Acclaims

"M-B" Automatic Air Line FILTER, REGULATOR and LUBRICATOR Assembly



The value of "M-B" Automatic Air Line Filters, Regulators and Lubricators is widely known for their effectiveness as a protection to Air Valves, Cylinders, Pneumatic Tools, etc.

"Your 'Sentinel of the Air Line' has been giving us very good service. We have had no complaints at all and I trust that we will be ordering more of them in the near future."

signed: **A. E. Cranston, Sr.**
PRESIDENT

Cranston Steel Strapping Co.
Oak Grove, Oregon

M·B PRODUCTS
46 Victor Ave.
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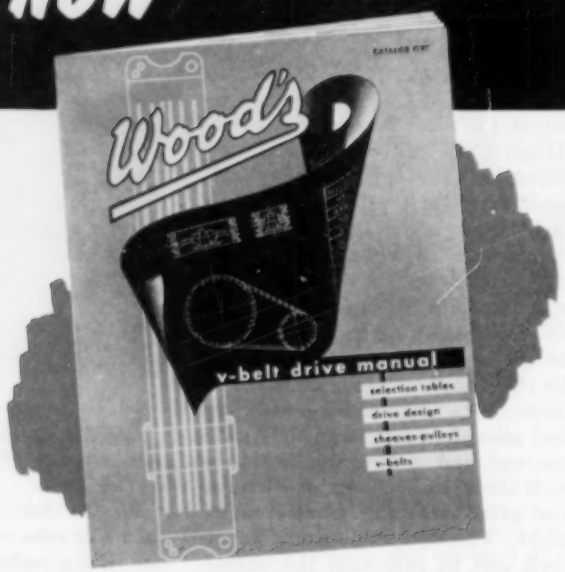
NOW—DRIVE DESIGN SIMPLIFIED



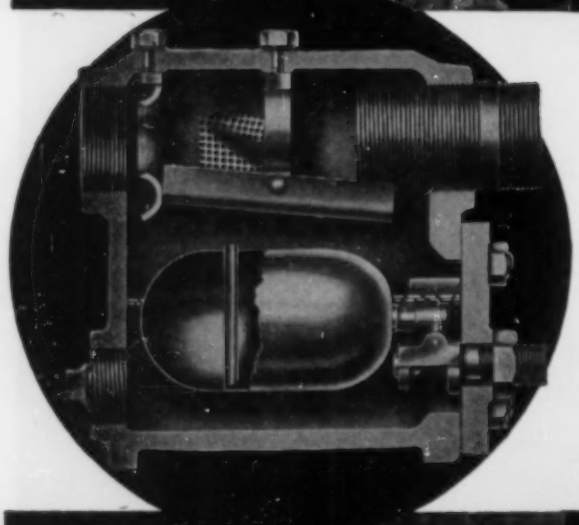
The most complete listing of pre-engineered stock drive tables published today. When using any standard motor it is simple to choose a drive with the proper horsepower capacity, center distance, belt length, and driven speed. Contains valuable data on drive design, sheaves and pulleys, V-belts of all designs.

T. B. Wood's SONS COMPANY
CHAMBERSBURG, PA.

Circle 24A on reply card

DRI AIR MAY BE INSTALLED BY SUSPENDING IT FROM THE PIPING WITHOUT ANY OTHER SUPPORT.

INCREASED PNEUMATIC EFFICIENCY WITH THIS AUTOMATIC SEPARATOR



PROTECT EQUIPMENT WITH

DRIAIR

SEPARATES • COLLECTS • DELIVERS

• DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

A TYPICAL INSTALLATION SHOWING DRI AIR STANDING ON A CONCRETE FLOOR NEXT TO THE WALL.

WRITE FOR BULLETIN DA WHICH FULLY DESCRIBES THE CONSTRUCTION AND OPERATION OF THE DRIAIR.

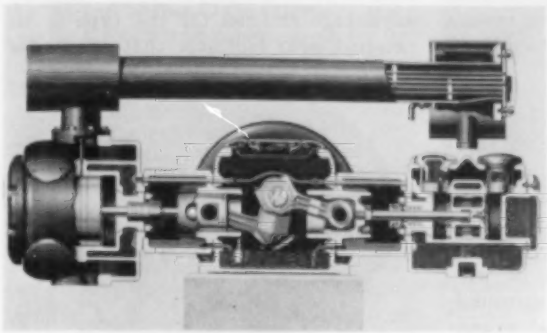
NEW JERSEY METER CO.

"SPECIALISTS IN COMPRESSED AIR DEVICES"

PLAINFIELD, NEW JERSEY

Circle 25A on reply card

Industrial Notes



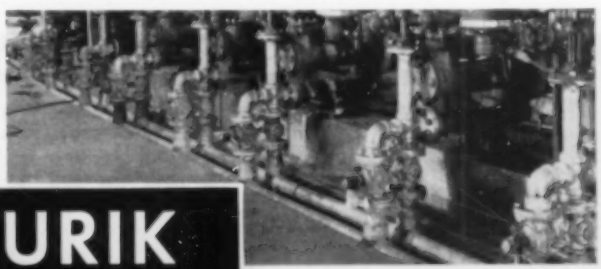
A packaged air compressor that is said to approach larger, more powerful and slower-speed units in efficiency and economy has been introduced by the Ingersoll-Rand Company. Classified as the PHE, the new heavy-duty machine is of the opposed-cylinder balanced type and driven by a direct-connected induction motor. The basic design is a 2-stage, 85-125 psi unit, but single- and multistage arrangements are available for higher pressures or for pumping vacuums. Piston and rod assemblies of like weight move in opposite directions on an 180° crank, thus equalizing all primary and secondary inertia forces without the aid of counterweights. The running gear is designed so that the full-floating bearings rotate slowly, taking the major thrust of each succeeding stroke on a different part of the shell. All three main bearings, which are interchangeable, are made of an aluminum alloy that has been found to be stronger than most bearing metals and to have higher heat conductivity, which results in cooler running. Fully shop assembled and ready for service, the compressor can be set up on a simple foundation and requires a minimum of floor space, piping and connections. It is suitable for use in factories, foundries, railroad shops, mines, powerhouses and on big construction jobs.

Circle 1E on reply card

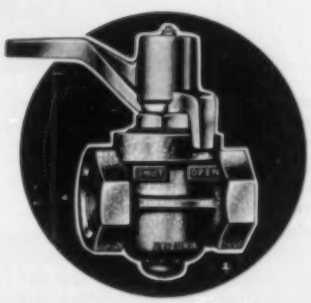
At a Woodworking Industries Show held recently in Grand Rapids, Mich., the United Shoe Machinery Corporation exhibited an automatic pneumatic tacker that is based on the company's long experience in designing and manufacturing fastening machines for its own industry. The assembly consists of a tack pot with a separating and feeding mechanism and of a hand-held gun suspended by means of a spring or counterbalance. The tool itself weighs only 3 pounds and, while in use, consumes on an average 6 cfm of air at 80 psi pressure. It is said to drive wire or cut tacks of steel or nonmagnetic metals at a rate of more than 300 a minute, to feed four sizes without changing fittings and as many as 20,000 tacks without reloading. The gun is tripped by a light touch of the nozzle to the work and will drive tacks upwards, sidewise at an angle and in confined or narrow places. As the accompanying picture shows, the flexible feed, signal and air lines are encased in a zippered cover to prevent tangling, and they are long enough to permit operating within a 16-foot radius around the tack pot. By providing the latter with a mobile mounting, the range can be extended within practicable limits.

Circle 2E on reply card

Lehigh Foundries, Inc., has announced a reciprocating air motor as an addition to its line of air-control equipment. A compact unit, it combines a double-acting cylinder, a 4-way free-flow slide valve, and independent speed regulators for piston-rod control in both directions. It can be operated by optional manual, electric or pneumatic controls, or by one of these means in one direction. Air motors with automatic return stroke or continuous cycling are also available. All the company's units feature sealed-in lubrication. The piston is hollow and filled with oil, which is fed by capillary action through small radial holes to a wick in a groove cut in the outer wall of the piston. In this way the inside surface of the cylinder is always coated with a film of lubricant that is said to insure a free-acting unit and to prevent stiffness



DeZURIK VALVES.. ...UNAFFECTED BY VIBRATION!



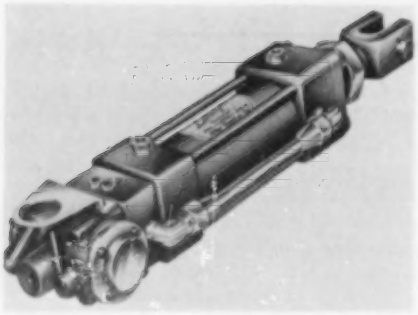
On compressed air lines, where surge and pulsation punish ordinary valves, DeZurik Valves have proven their superiority. They last longer, hold tighter, require less attention!

The exclusive rubber-faced eccentric plug of a DeZURIK VALVE seals *tight* — despite grit or moisture in the compressed air line. The plug is non-lubricated, e-a-s-y operating, positive acting. In a full range of sizes and types.

WRITE FOR DETAILS AND RECOMMENDATIONS

DeZURIK SHOWER COMPANY SARTELL, MINNESOTA

Circle 26A on reply card



at the break-away. Lehigh air motors now come in bores of 1½, 2, and 3 inches with any desired stroke and with nine different mountings. They are suitable for pressures up to 200 psi and can be furnished with or without adjustable cushions at either or both ends. Only one air connection is needed.

Circle 3E on reply card

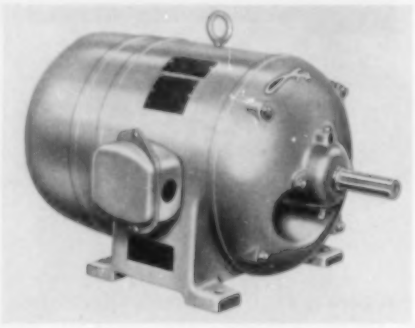
We are familiar with capsules that dissolve inside the body and release the medicine the doctor has prescribed for what ails us. This same idea is being applied to good advantage by Electro Refractories & Abrasives Corporation which supplies calcium boride used in making copper castings to rid the molten metal of oxygen that lowers copper's electric conductivity. Formerly the chemical was sold in bulk; now it is packaged in copper tubes, each 5 inches long, 2 inches in diameter and containing 4 ounces, or sufficient to treat 100 pounds of metal. Just before the latter is poured, a capsule is plunged into the crucible where the intense heat of the molten mass causes the shell to dissolve and release the deoxidizing agent.

Circle 4E on reply card

Two new series of silencers for compressors, blowers, vacuum pumps and other machines expelling high-velocity air to atmosphere have been developed by Burgess-Manning Company. They are of the straight-through type with transparent, perforated tubes surrounded by a deep layer of special sound-absorbing material suitable for use under moisture-free air conditions and at considerably higher temperatures than the standard 200°F. The CA Series is available in pipe sizes up to 6 inches and the LCA in larger sizes.

Circle 5E on reply card

Short over-all length is one of the features of the new Brakemotor recently announced by Louis Allis Company. The reduction is made possible by utilizing the end bracket as an integral part of the brake and, according to the manufacturer, permits Brakemotors to be used in many places where they could not be installed because of space limitations. The unit is available in NEMA motor-frame sizes from 203 to 326 and is provided with a disk brake designed to furnish maximum continuous-duty torque from 3 foot-pounds in the smaller sizes to 50 in the largest ones. Another advantage claimed for the type is an external wear indicator that eliminates



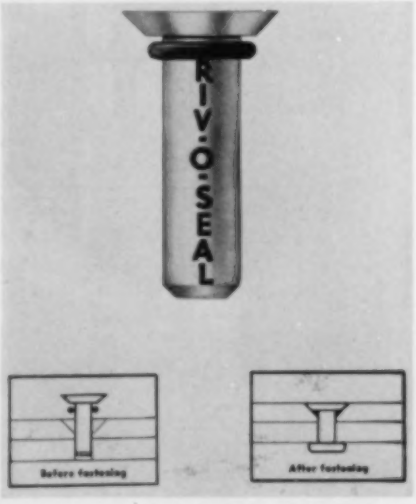
cover removal and continual brake lining inspection and shows whether the brake is operating properly at each engagement. In addition, there is one torque-adjustment nut which sets the brake for any rating to maximum.

Circle 6E on reply card

Windows as high as 90 feet above street level, as well as wood, metal, brick and other surfaces, can be washed by men standing safely on the ground, says the J.B. Sebrell Corporation, by use of its lightweight aluminum poles and Waterflow Brushes. The poles come in 5-foot sections each having one expanded end into which the succeeding length is inserted and secured by two bolts and nuts. The brush—an oblong, heavy-duty model for industrial service and a smaller, round one for home use—receives water, controlled by a cut-off valve, from a garden hose.

Circle 7E on reply card

Riv-O-Seal is the name of a device developed by the Franklin C. Wolfe Company for sealing flush rivets and screws where full metal-to-metal contact of faying surfaces must be maintained without loss of tightness through cold flow. Based on the firm's Lock-O-Seal principle using the O-Ring method, it is



Sauerman installations provide economical handling of a wide variety of bulk materials, from bauxite to zinc ore . . . at rates ranging from 10 to 800 cu. yds. per hr. Storage areas range from a small bin to ten acres or more.

Quick change from stockpiling to reclaiming is accomplished by unclamping and re-attaching the operating cables so as to turn the bucket around when the power is applied. Non-caving or free-flowing materials are handled with equal efficiency.

The operator can be located in a safe cab overlooking the work area. Many Sauerman installations are remotely operated through air or hydraulic controls.

Let Sauerman engineers show you how to use your storage area to its fullest extent. Send for Catalog E, *Bulk Storage by Power Scraper* and 32 *Tested Methods For Handling Bulk Materials.* Request the following Field Reports:

FR-224 Handling Ore with Drag Scrapers
FR-104 African Storage of Iron Ores

SAUERMAN BROS., Inc.
548 S. Clinton St., Chicago 7, Illinois

Circle 27A on reply card

said to provide a seal against low- and high-pressure gases or fluids without the need of pastes. It is especially suitable in aircraft and other industries for work such as assembling cabin fuselages, integral tanks, instruments and electronic devices.

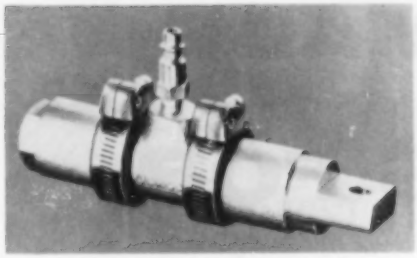
Circle 8E on reply card

To fill the gap between its 2½-cubic-yard Model 54-B and 4-yard 88-B, the Bucyrus-Erie Company has developed a 3-yard shovel that incorporates their engineering features and is readily convertible into a dragline, clamshell or lifting crane. The new unit—the 71-B—is powered by a 6-cylinder diesel engine with torque converter drive (machine is supplied without converter). Straight propulsion and gradual or sharp turns are achieved through two multiple jaw clutches and a pair of steering brakes all of which are spring set and air released.

A simple mechanical interlock prevents simultaneous disengagement of both clutches for safe steering on grades without blocking the crawlers. The standard boom is 60 feet long and can be extended to 110 feet by removable inserts. Twin ropes are used for crowd and a single line for retract. The shovel is air controlled (not just air assisted) except for the propel and swing jaw clutches and the drum brakes. The 71-B is available with four optional A-frames and four crawler mountings.

Circle 9E on reply card

For use in areas close to office personnel, the Vibron Division of Burgess-Sterbentz Corporation has introduced a line of small pneumatic vibrators provided with mufflers. Designed to prevent arching, clogging or sticking of inert bulk materials without the usual noise of the impact type and the sounding-board effect of bins, the powerful vibratory action claimed for the units is induced by a piston that reciprocates in a cylindrical chamber under the force of compressed air introduced alternately at opposing



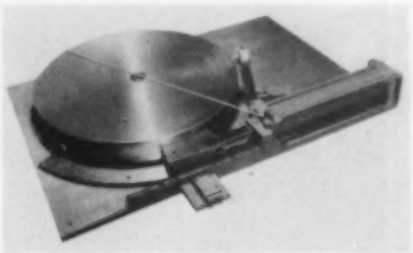
ends of the cylinder. Air at 30 to 140 psi line pressure is used, and up to 5000 strokes are delivered per minute. A feature of the series is a self-contained supercharger that considerably increases the operating air pressure and power output. The vibrator is 6¾ inches long and furnished with standard tong or special mountings.

Circle 10E on reply card

As the result of a new design developed by Jamesbury Corporation, valves of stainless and carbon steel, aluminum, brass, bronze, monel and other wrought alloys with Buna-N, Neoprene, Silicone, Teflon or Kel-F seats and packing are now readily available. Because of this wide choice of materials it is an easy matter to provide pipes with valves of the same kind of metal to prevent corrosion and electrolytic action, two common causes of valve failure. The unit is based on the double-seal ball principle and, according to the manufacturer, permits full nonturbulent flow and maintains shutoff under vacuum and at working pressures of 300-600 psi even under abrasive or corrosive conditions. Opening and closing are effected by one-quarter turn of a lever. No lubrication is required. The valves are stocked in sizes from ¼ inch to 2 inches.

Circle 11E on reply card

Air-Hydraulics, Inc., has announced an index table that differs from equipment of this kind in that the entire operating mechanism is on the outside where adjustments can be made or working parts removed without disturbing table or tooling. The model is available

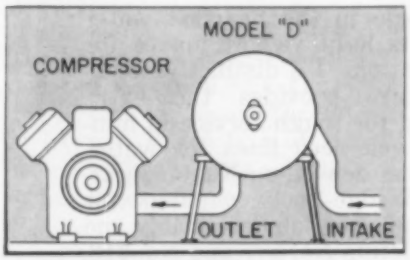


with six or more stations in diameters ranging from 20 to 48 inches and may be equipped for hydraulic or pneumatic operation (air cylinders use 60 to 175 psi line pressure). The index speed and cushion are adjustable to compensate for variations in size and load.

Circle 12E on reply card

★ Longer Life For Compressor Parts

Abrasive dust is responsible for most of the wear in your air compressor. The model "D" AEROTURN*, attached to the air intake, removes virtually all wear-causing particles before they enter the compressor.



*Manufactured under Hersey Patent Rights
Other patents pending

Based on the reverse-air-jet cleaning principle, this small, compact air filter is self-cleaning — is easy to install, and will pay for itself by reducing compressor repair to a minimum. No external blower is needed since the compressor suction is sufficient to effectively draw air through the Model "D" without sacrifice of compressor capacity.

Write today for more information on our new Model "D" AEROTURN Bulletin and see how a T & H installation can solve your compressor air cleaning problem efficiently and economically.

TURNER & HAWS ENGINEERING CO., Inc.
87 Gardner Street
West Roxbury 32,
Massachusetts

AEROTURN

Name _____
Company _____
Address _____
_____
_____

Circle 28A on reply card

MAN-MADE RIVERS FOR MINING SERVICE

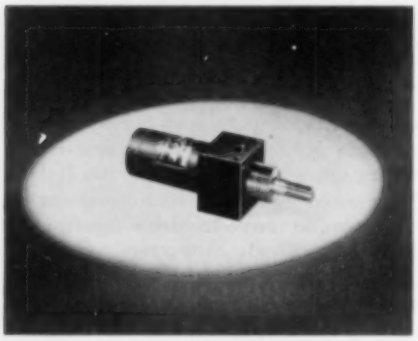
Naylor pipe is right at home in the heaviest water traffic in mining service. Its light weight makes for easier handling and installation. Its distinctive lock-seamed-spiralwelded structure provides the extra strength and safety required for tough service in mining applications. Whether you need lines for water, air, tailings or sludge, you can depend on Naylor lightweight lines and Naylor Wedge-Lock couplings for the right combination to handle the job dependably and economically. Write for Bulletins No. 507 and No. 513.

NAYLOR PIPE

Naylor Pipe Company • 1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

To its line of air or hydraulic cylinders, Carter Controls, Inc., has added a small clamp-type unit for multiple holding operations and for service in connection with jigs and fixtures, toggles, springs, valves, etc. Of steel construction, it has bronze bearings and synthetic piston packing which permits its use where



temperatures range from minus 55 to plus 250°F. There are six standard styles, both single- and double-acting, with a 1- or 2-inch stroke and universal mounting. Over-all dimensions in withdrawn position (2-inch stroke) are: length 5 inches and height and width 1½ inches, respectively. Special sizes and mounts are made to order.

Circle 13E on reply card

QUOTES

—FROM HERE AND THERE

Role of Engineers

"We (engineers) do a wonderful job of running the slide rule but only a fair job of interpreting what we are doing to the man who benefits from our labor. We take too much for granted. Although there are twice as many engineers as attorneys in the country, 28 of the 48 state governors are attorneys and none is an engineer. There are 53 lawyers and only two engineers among the 96 U.S. Senators . . . . These men deal daily with the fruits of engineering accomplishments."

From a talk by A.C. MONTEITH, *new head of the American Institute of Electrical Engineers.*

Nerves of Industry

"Three hundred years ago, we entered what became known as the era of the Industrial Revolution. At that time, men began substituting mechanical power for animal muscle power. By World War II the art of using mechanical power had reached the point where practically all major work was being done by machines. In effect, machines took over the job of human muscles. Today we are on the verge of developing complete 'nervous systems' for those mechanical muscles—the nervous systems which will not only tell machines and

entire production lines what to do but how to do it, when to do it, and how often to do it. The use of new materials such as silicon, germanium, and others . . . will do much to expand the use of these 'nervous systems' ".

DR. S. J. ANGELLO *of Westinghouse Electric Corporation in paper given at summer meeting of American Institute of Electrical Engineers*

Air-cooled Submarine

"Air conditioning in the world's first atomic-powered submarine—the U.S.S. *Nautilus*—has a special control system which was developed by Minneapolis-Honeywell Regulator Company under sub-contract from Carrier Corporation, which furnished the huge air-conditioning system. The control set-up divides the submarine into 10 zones and uses 15 pneumatic thermostats and humidity controls, plus 12 relays, to monitor interior conditions constantly and adjust the air-conditioning system accordingly. The cooling system, believed to be the largest ever installed for undersea use, could condition a six-story building."

Industrial Control News

Jersey Mosquitoes Ground Big Airplanes

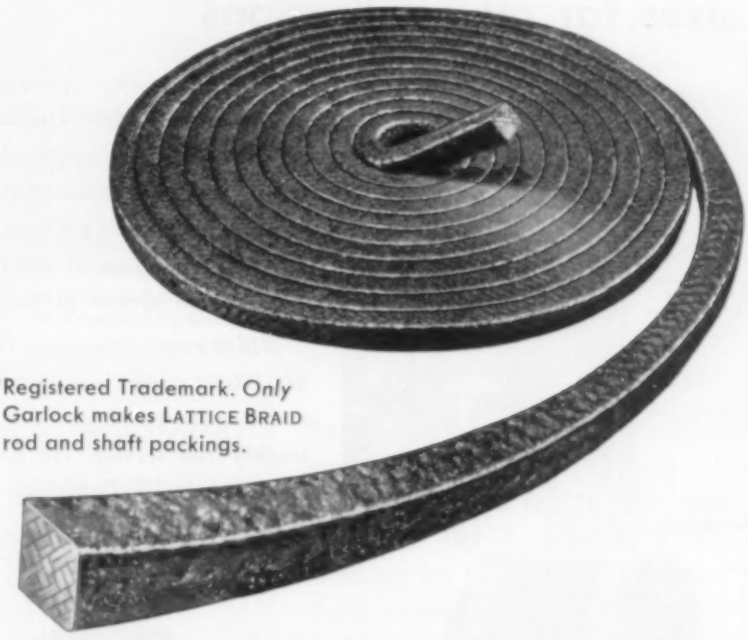
"The weirdest story of the American Airlines strike that ended a couple of days ago is how a swarm of mosquitoes stopped A. A.'s powerful fleet. This happened when pilots attempted to ferry some of the ships from Newark, where they had been laid up, to their hangars at La Guardia Airport.

"A. A. ground crews had kept the great planes immaculate, had checked and rechecked them through their long idle period. But when the ferry pilots revved up the planes' engines, the airspeed indicators and the altimeters, both of which work off compressed air absorbed through intake ducts, were utterly dead. Inspection showed the ducts were clogged with Jersey meadows mosquitoes, some dead, some alive.

"After the skeeters were blown out, the huge ships worked fine again."

New York Times, August 27

United Towing Co. reports LATTICE BRAID* *outlasts* previous pump packings 26 to 1



*Registered Trademark. *Only* Garlock makes LATTICE BRAID rod and shaft packings.

United Towing Company of Wilmington, Cal. tried a number of packings on their rotary gear pumps handling *cold molasses* and operating at 120 p.s.i. In starting the pumps, the cold molasses would ruin these packings. In fact, no packing would last more than 8 to 10 hours. That is, until United Towing tried rugged LATTICE BRAID asbestos packing with wire insertion and wire corners. In actual running time, LATTICE BRAID has lasted for 260 hours—26 times longer than any previous packing.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID *Packings. Contact your Garlock representative or write for new folder AD-131.*

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

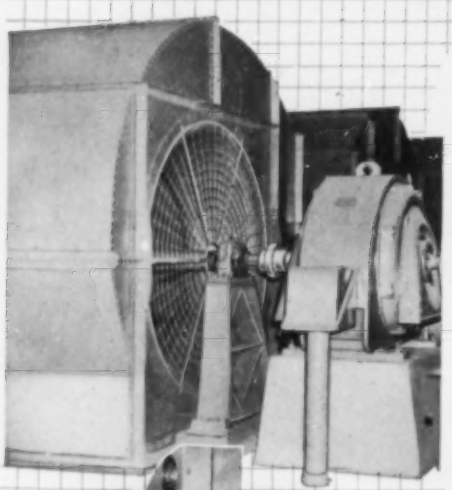
Circle 30A on reply card

WALDRON

ADVANCED DESIGN

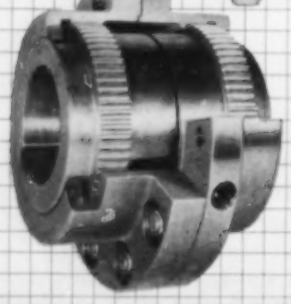
GEAR COUPLINGS

are available in all types and sizes for all applications

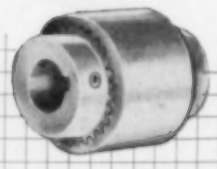


Whatever your drive problem, there's a WALDRON Coupling to meet it. All-steel couplings for rugged work, all-nylon couplings where the corrosion problem is present, combinations of both for a variety of special problems.

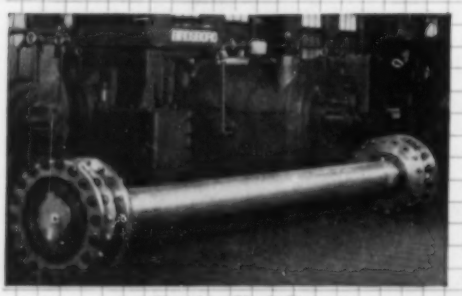
Whichever you use, the WALDRON design and construction is your assurance of long trouble-free service. The best known name in Couplings — WALDRON!



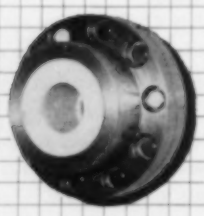
Above—Steel Coupling On Tunnel Fan



Above—All Nylon, Non-Corrosive Type



Floating Shaft Type For Steel Mill



Combination Nylon Hub and Steel Sleeve

WALDRON couplings are available in sizes up to 18" shaft diameter. We specialize in furnishing couplings for unusual applications and services. We would be pleased to send you our latest bulletin 55C upon request.

JOHN WALDRON CORPORATION
New Brunswick, N. J.
Since 1827

Sales Representatives In Principal Cities

Circle 31A on reply card

Books and Industrial Literature

The Heat Exchange Institute has announced the third edition of its *Standards and Typical Specifications for Deaerators and Deaerating Heaters* designed to assist purchasers of such equipment. A completely revised and rearranged work, it is divided into sections on nomenclature, definitions, types, standards of construction, rating and performance standards and accessories and contains a new table giving storage in minutes and cubic feet for capacities from 10,000 to 1,600,000 pounds per hour. It also includes a chart showing flow through valves in pounds per hour, temperature-pressure and pressure-temperature conversion tables and diagrams of typical arrangements of deaerating units. Published by Heat Exchange Institute, 122 E. 42nd Street, New York 17, N.Y. Price $1, plus twenty cents mailing charge outside the United States.

Lubricating Oils for Industrial Engines is the title of a 48-page booklet that lists the trade names of more than 1200 lubricating oils offered by 366 companies for heavy-duty gasoline and diesel engines. It was compiled to enable those in the market for a particular brand to ascertain what properties are claimed for it. The oils are divided into three groups in accordance with the service requirements common to industrial-engine operation. Published by International Combustion Engine Institute, 201 N. Wells Street, Chicago 6, Ill. Price twenty cents, plus postage for more than one copy.

Bulletin 17-F, obtainable from Bailey Meter Company, concerns instrumentation for the modern process plant. It describes and illustrates the equipment used and includes basic specifications for measuring, transmitting, receiving, interpreting and controlling eighteen variables normally encountered in production processes.

Circle 14E on reply card

Condura, a high-tenacity rayon, is the subject matter of a booklet entitled *Mine and Quarry Facts* printed by E.I. du Pont de Nemours & Company to acquaint manufacturers of conveyor belting, flat and V-belts for power transmission, tires and hoses for those services with the ruggedness, strength and durability of that material.

Circle 15E on reply card

Aluminum Company of America offers a 24-page illustrated booklet entitled *Alcoa Aluminum Heat Exchanger Tubes.* Designed as a basic reference source for engineers and executives, it deals with the subject from every angle, lists typical commodities handled or processed, and enters into such matters as fabrication, heat transfer, fluid flow, mechanical characteristics, etc.

Circle 16E on reply card

Wheelabrator steel shot, a cast-steel heat-treated abrasive for blast cleaning and peening is the subject of Bulletin 89-A published by American Wheelabrator & Equipment Corporation. Of eight pages, it discusses factors vital to the efficient and economical use of abrasives, presents a tabular comparison of the characteristics of the various metallic types and gives other pertinent data.

Circle 17E on reply card

Ingersoll-Rand Company has published a bulletin on its Class BPM mixed-flow and APL axial-flow pumps for process and paper-mill application. Sectional drawings show the features of the units and are accompanied by detailed explanations of each.

The pumps are available in sizes of 10 to 24 inches, pressures to 25 psi, capacities up to 16,000 gpm, and in carbon steel, stainless steel, cast iron, bronze and nickel to meet varying service needs.

Circle 18E on reply card

The National Safety Council has prepared an 8-page booklet, entitled *Plus Costs of Accidents*, that is intended specifically for firms that employ comparatively few workers and have no safety staff.

Circle 19E on reply card

A comprehensive listing of standard sizes and net prices of Norton diamond grinding wheels and hones is contained in Catalogue No. 1233 recently released by that company. Of 52 pages, it also includes instructions on their selection and gives information on markings and standard shapes.

Circle 20E on reply card

Bulletin PSG-1 deals comprehensively with Henry Vogt Machine Company's package-unit steam generator available in capacities from 10,000 to 30,000 pounds of steam per hour in 175, 250 and 375 psig pressure. They are adaptable to most plant needs, easily skidded on a concrete foundation and ready for operation when pipe, electrical and stack connections are made.

Circle 21E on reply card

Tensioning Materials for Prestressed Concrete is the title of a catalogue obtainable from John A. Roebling's Sons Corporation. In addition to data and charts on the characteristic properties of the wire and strand it supplies for the purpose, the 14-page book describes and illustrates tensioning applications and discusses construction jobs on which prestressing has been used.

Circle 22E on reply card

A generous section of a 19-page catalogue on Imperial Brass Manufacturing Company's tube-working tools is given over to two new products for making precision 45° and 37° double-lap flares on soft-steel, copper, aluminum, stainless-steel, titanium and other metal tubing. Two operations are involved: first the tube is belled and then it is folded down over itself. Tools can also be used to make single flares.

Circle 23E on reply card

The latest technical bulletin in a series issued by Johns-Manville under the title of *The Gasket* discusses the effect of flange surface finishes on sealability and joint performance. It is intended to be of aid to those who buy, specify or design joints using gaskets and provides a basis upon which to select the flange surface finish most suited for a given type. The authors, John W. Axelson and Heber H. Dunkle have long been closely identified with gasket development and application.

Circle 24E on reply card

A 76-page, illustrated multi-V belt engineering handbook with a convenient gueid to designing standard and high-capacity drives has been published by The B.F. Goodrich Company, Industrial Products Division, Akron, Ohio. It contains new horsepower rating tables covering speeds from 100 to 6000 feet per minute that closely approximate operating conditions and make it possible to design or redesign V-belt drives at lower cost by reducing the number of belts for a given load. Other tables deal with such aspects as installation and takeup allowance, belt speeds, length correction factor, calculation of center distance, preengineered drives calculated with stock sheaves and stock sizes of belts, etc. This comprehensive book may be obtained free of charge by written request on a company letterhead.

CONTINENTAL RED SEAL®

means more and better power

JAEGER MODEL 4½HM-D Mixer. Capacity 4½ cu. yd. Powered by Continental Red Seal F-6226 engine.

NO OTHER ENGINE GIVES YOU ALL THESE ADVANCED ENGINEERING FEATURES

PATENTED INDIVIDUAL PORTING
•
FULL-LENGTH WATER JACKETS
•
TOCCO-HARDENED COUNTER-BALANCED CRANKSHAFT
•
LEAKPROOF WATER PUMP
•
ALLOY STEEL VALVE SEAT INSERTS
•
PATENTED OIL AND DUST SEALS
•
POSITIVE ROTATION EXHAUST VALVES
•

Continental Red Seal power for specialized applications is now available at levels ranging from 2 h.p. up to more than 1,000, in liquid-cooled and air-cooled models, for use on all standard fuels. And, strictly on the score of PERFORMANCE—economy, dependability and low maintenance cost—it is finding its way into more and more leading makes of specialized machines. The equipment builder's good name, and the end-user's satisfaction, are double-clinched by this fact: EVERY CONTINENTAL RED SEAL IS NOT ONLY BUILT FOR ITS JOB, BUT BACKED BY PARTS AND SERVICE FACILITIES COAST TO COAST.

•

A COMPLETE LINE OF 4-CYCLE AIR-COOLED ENGINES

Continental also builds air-cooled models, from 2 to 3 h.p., for heavy-duty applications in industry and on the farm. They embody the exclusive Contex® external ignition system, greatest air-cooled engine advance in recent years. For information, address Air-Cooled Industrial Engine Division, 12800 Kercheval Ave., Detroit 15.

6 EAST 45TH ST., NEW YORK 17, N. Y. • 6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF. • 910 S. BOSTON ST., ROOM 1008, TULSA, OKLA. • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Continental Motors Corporation
MUSKEGON, MICHIGAN

Circle 32A on reply card

No place for a motorist—yet. This photograph shows the difficulties encountered in building a road through Catskill Mountains region.

Carving a path for New York Thruway

Wagon drills make the dust fly as Bethlehem hollow drill steel bites into the limestone. This steel provides economical drilling, time after time.

One of the major problems involved in constructing a 22-mile section of the New York Thruway in the Catskill Mountains, between Ravena and Palenville, N. Y., was the removal of approximately 2,000,000 cu yd of medium-hard limestone.

The contractor for the rough grading, as well as for the paving which followed, was The Savin Construction Corp., East Hartford, Conn. In the rock-removal operations, the Savin organization used wagon drills equipped with Bethlehem hollow drill steel, 1¼ in. round, fitted with carbide-insert bits. The approximate footage drilled was 1,500,000 lineal feet, with some of the blast holes going as deep as 30 ft. The project manager, B. A. Wilder, reported satisfactory results in every way with Bethlehem Hollow.

Yes, you can always count on good performance with Bethlehem Hollow, even under the toughest drilling conditions. Bethlehem Hollow has a wide quenching range, making it easy to heat-treat for the ideal balance of hardness and wear-resistance. It makes long-wearing threads, and tough shanks. It's well able to take the fast, hard blows of modern rock drills.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

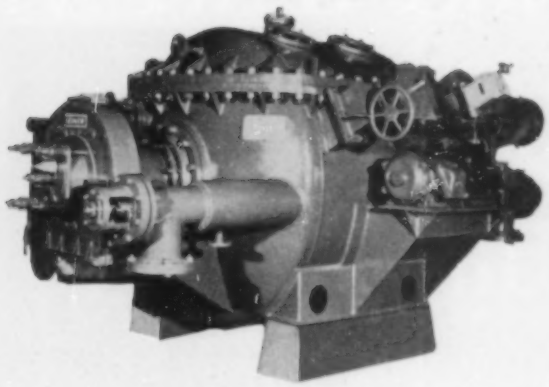
Two Grades of

BETHLEHEM HOLLOW DRILL STEEL

CARBON · ULTRA-ALLOY (chrome-moly)

BETHLEHEM STEEL

Circle 33A on reply card



Price or Performance?

When you have a place for a filter in your flow sheet and the function of this particular step is important, your purchasing should be done on the basis of performance and not price.

If you buy on the basis of performance, with specifications and design guaranteed to meet the performance, your first choice will be an Eimco.

If your work, however, can be satisfied with so many square feet of filter area and your first consideration is price, there are many able to supply your needs.

Eimcos are not cheap because they have built into them the heavy construction, the precision design and the unique know-how that comes with more than half a century of sucecssful experience.

Eimco will devote to your filtration problem, be it vacuum or pressure, the skill of its trained engineers in research, testing, design and construction. It will then guarantee successful results duplicating the test work necessary to prove your flow sheet.

Does your process need the best? If it does and you are willing to look beyond first cost, it will pay you to have Eimcos at the start.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

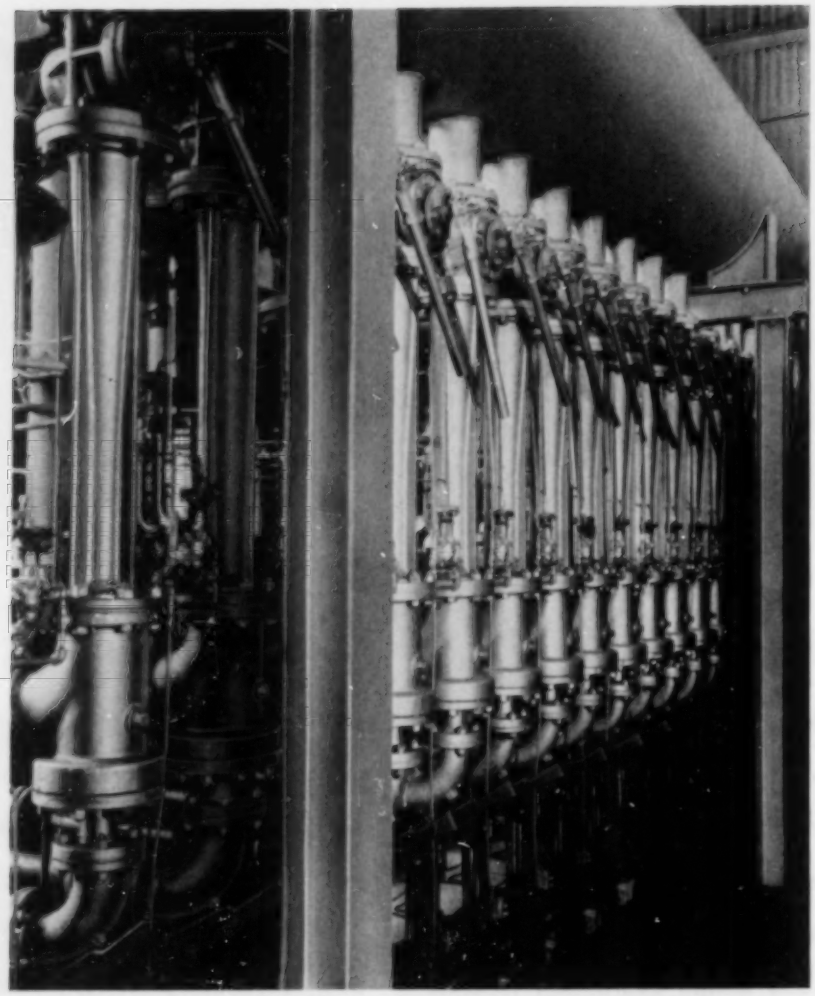
New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Texas Birmingham, Ala. Duluth, Minn. Kellogg, Ida. London, Eng. Paris, France Milan, Italy

B-73

You Can't Beat An Eimco!

Circle 34A on reply card

PIPE ORGAN FOR HOT TUNES



I-R Ejector Jets automatically maintain desired BTU content of gas mixture for firing metallurgical furnaces at Fairless Works.

The pipes in this "organ" produce no music. Yet the steady roar of gases which they control is music to the ears of the utility men at U. S. Steel's new Fairless Works. For this bank of fifteen I-R ejectors plays a major role in keeping the furnace fires burning at constant, high efficiency.

The reheating and pit furnaces at Fairless normally burn coke oven gas. At times, however, there isn't enough of it and natural gas must be introduced as fuel. If the natural gas were burned in its virgin state the burners would have to be readjusted every time, since coke oven gas has only half the BTU value of natural gas. That's where the jets come in. They mix just enough air with the natural gas to give it the same heat flow factor as coke oven gas. The natural gas is expanded through the nozzle of the jet, picking up air through the suction. Gas flow is regulated automatically according to load requirements by cutting any of the fifteen jets into or out of the system.

This is another example of how Ingersoll-Rand experience in the design and engineering of steam jet ejectors was able to solve a specific operating problem. The same time-saving, cost-saving service is available for *your* problems, too. Just call your nearest I-R representative or branch office.

Ingersoll-Rand

4-86 11 Broadway, New York 4, N. Y.

PUMPS • COMPRESSORS • GAS & DIESEL ENGINES • ROCK DRILLS • VACUUM EQUIPMENT • AIR & ELECTRIC TOOLS & HOISTS

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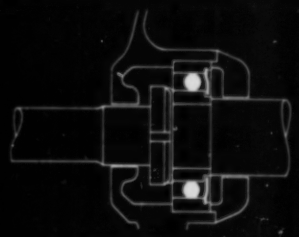
Circle 36A on reply card

Here's another reason why

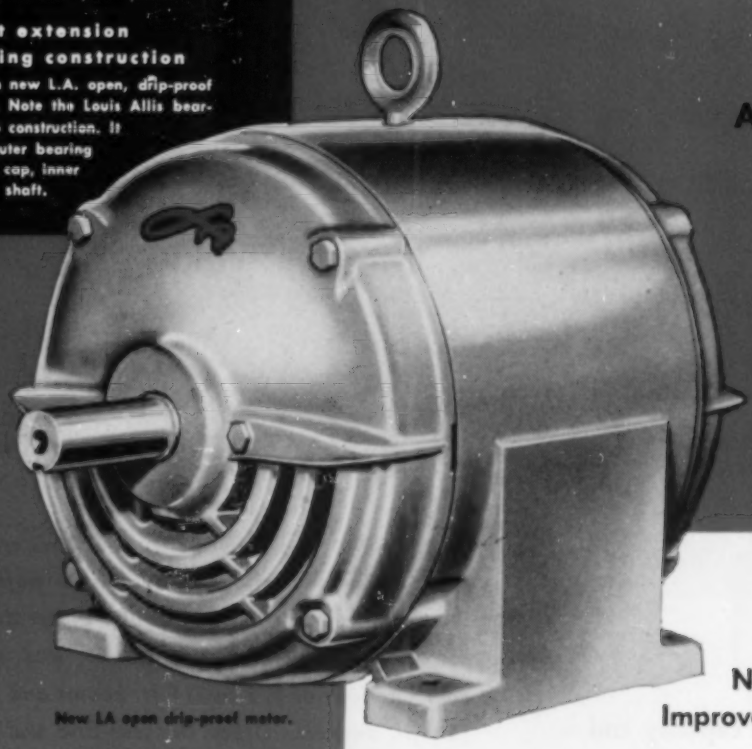
the NEW L.A. *Line*

by the Louis Allis Co.

is your BEST *electric motor* BUY



Shaft extension bearing construction used in new L.A. open, drip-proof motors. Note the Louis Allis bearing-cap construction. It locks outer bearing race to cap, inner race to shaft.



New LA open drip-proof motor.

A brand-new power package, completely redesigned inside and out

with NEW BEARING CONSTRUCTION

plus

New modern styling
More compact design
New conduit box arrangement
Improved ventilation and better protection
More versatile mounting

HERE'S the locked bearing construction that makes the new L.A. motors even better—gives them extra life, extra dependability. It positions the rotor . . . limits shaft end-play . . . gives you ample V-belt drive capacity. You get factory pre-lubrication, too, with a new, improved grease-retaining system that saves servicing and maintenance — for years of attention-free operation under most conditions.

That's not all! You get standard bearings in every unit — sizes specially selected to be easily obtainable from local stocks. And there's no need to tear the motor down to get bearing numbers — they're stamped right on the new motor nameplate.

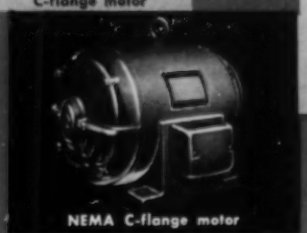
Add this modern, dependable bearing construction to all the other features and you see why the L.A. line is your best motor buy. Get the complete story from your nearby Louis Allis Sales Engineer.

We specialize in
SPECIAL MOTORS *and*
PROMPT DELIVERY, TOO

There's a Louis Allis special motor for your toughest application. Whatever electrical or mechanical modifications you need, check first with Louis Allis.

Vertical NEMA C-flange motor

NEMA D-flange motor

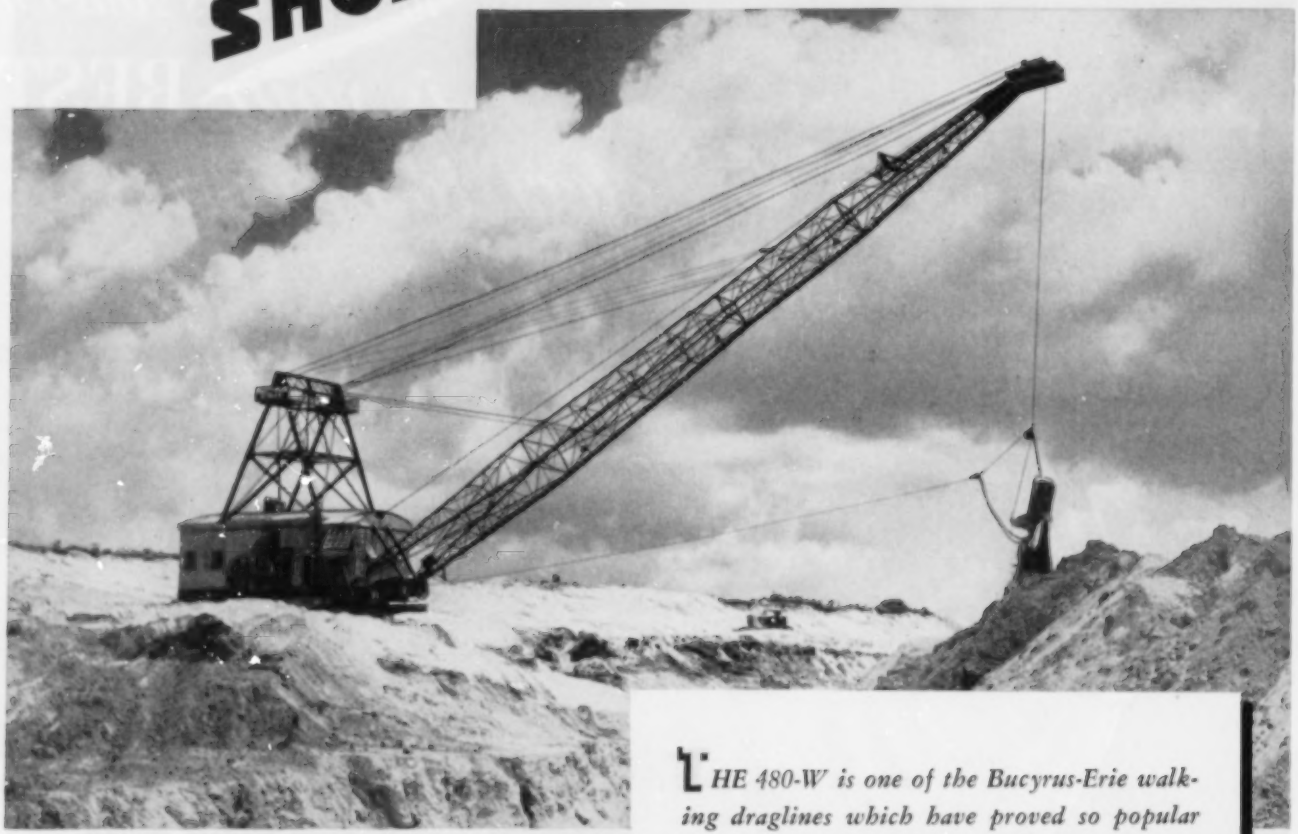


NEMA C-flange motor

THE LOUIS ALLIS CO.
MILWAUKEE 7, WISCONSIN

LA-105

LONG ON OUTPUT
SHORT ON UPKEEP



THE 480-W is one of the Bucyrus-Erie walking draglines which have proved so popular for stripping. It is available with either diesel or Ward Leonard electric power, and with combinations of 175 to 215 ft. booms and 8 to 12 yd. buckets. Other Bucyrus-Erie walking draglines have bucket sizes from 4 to 30 yd. and boom lengths from 110 to 235 ft.

Long working reach, large capacity and easy, accurate move-ups are some of the characteristics that make Bucyrus-Erie walking draglines "long" on output for economical stripping.

The many users of these outstanding machines have found them equally "short" on upkeep. This reflects careful, proved engineering, and correct balance of weight, power and strength that helps hold down wear and lengthen life.

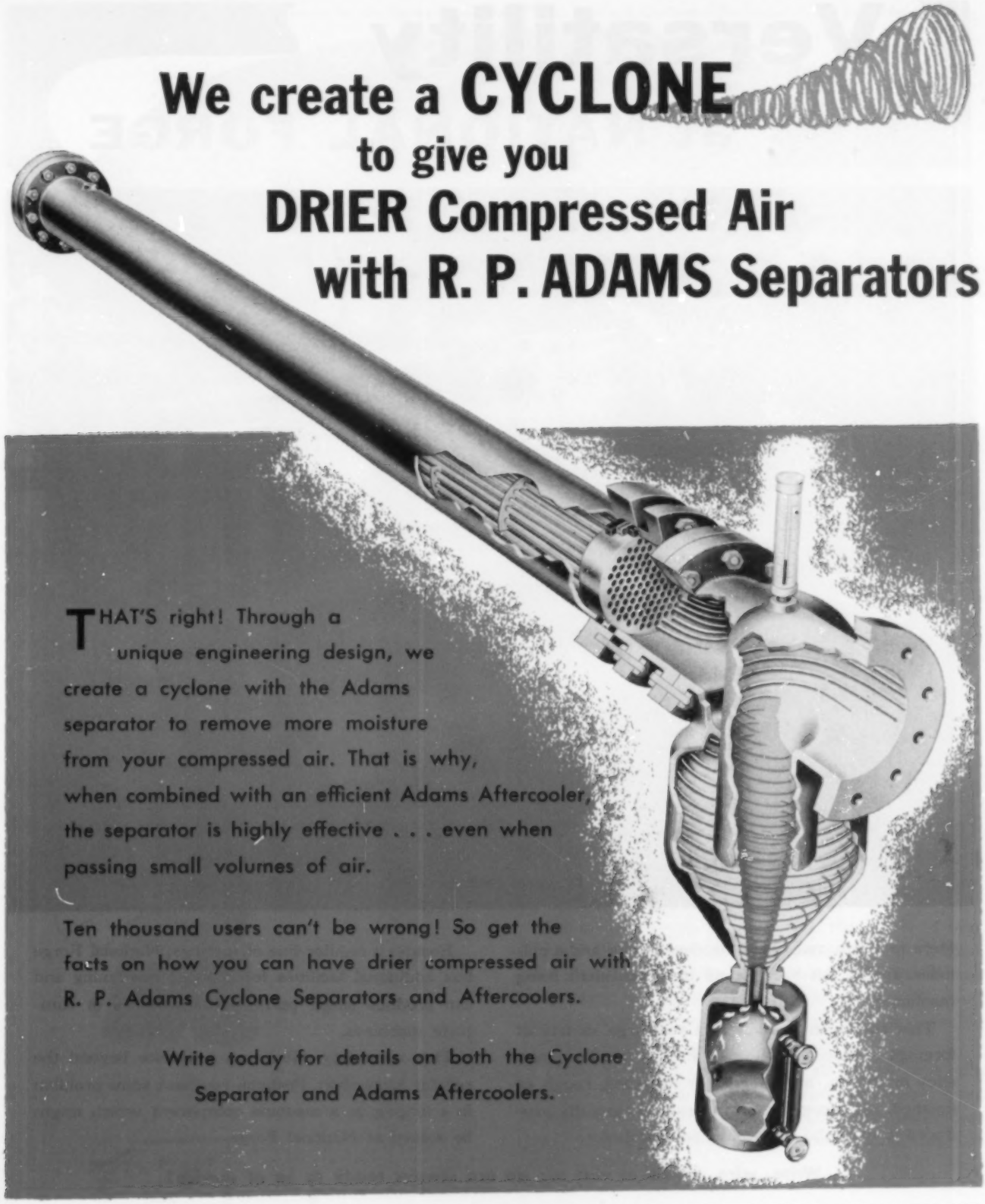
If you are interested in big-capacity, low-cost stripping, let us tell you more about features that have made Bucyrus-Eries the world's most preferred walking draglines.

11L54C

South Milwaukee **BUCYRUS ERIE** Wisconsin

Circle 37A on reply card

We create a CYCLONE to give you DRIER Compressed Air with R. P. ADAMS Separators



THAT'S right! Through a unique engineering design, we create a cyclone with the Adams separator to remove more moisture from your compressed air. That is why, when combined with an efficient Adams Aftercooler, the separator is highly effective . . . even when passing small volumes of air.

Ten thousand users can't be wrong! So get the facts on how you can have drier compressed air with R. P. Adams Cyclone Separators and Aftercoolers.

Write today for details on both the Cyclone Separator and Adams Aftercoolers.

R. P. ADAMS Co., Inc.

209 EAST PARK DRIVE

BUFFALO 17, N. Y.

R. P. ADAMS CO., INC.
209 East Park Drive
Buffalo 17, N. Y.

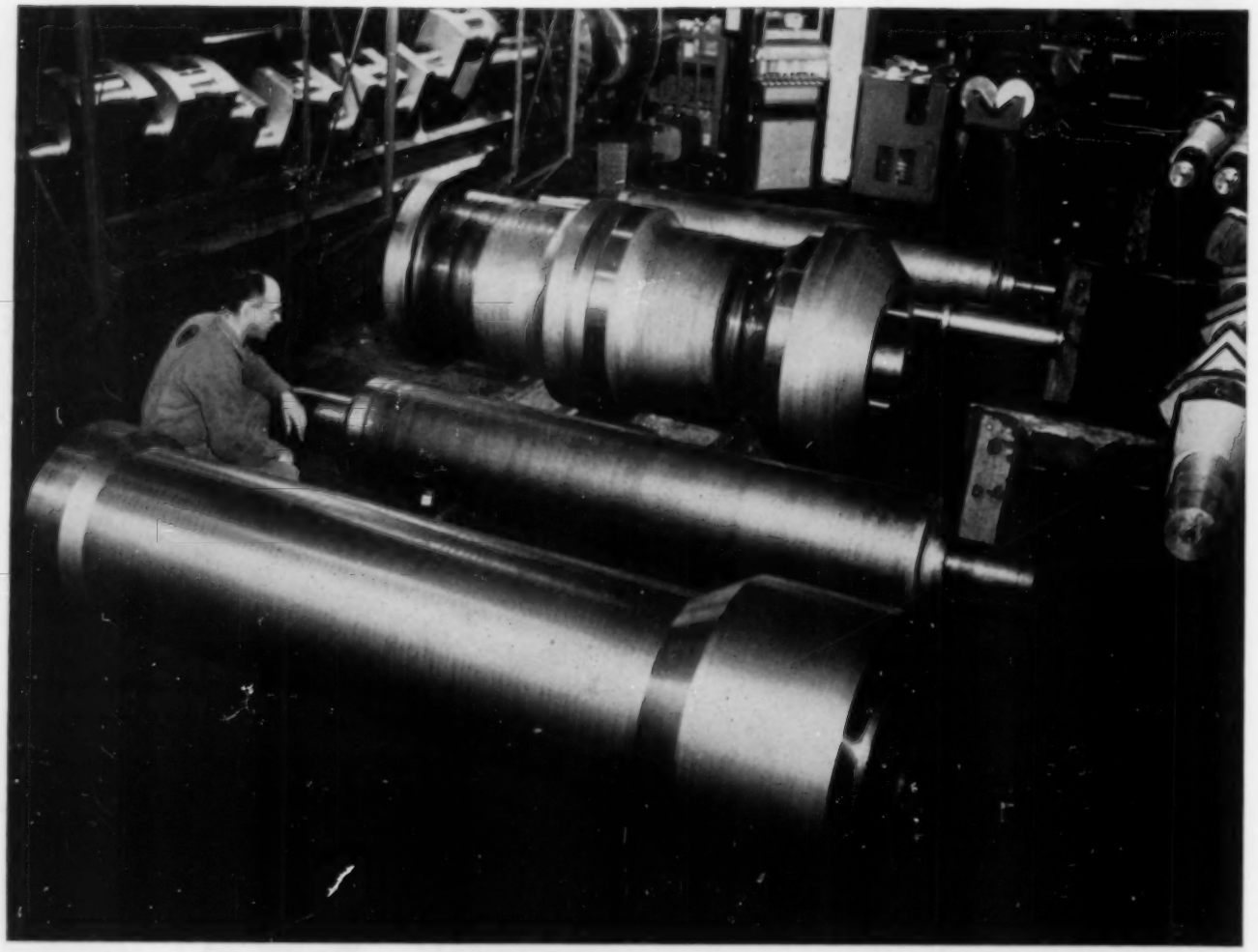
Please send my FREE copy of Bulletin #177 on Adams Cyclone Separators and Aftercoolers.

Name..... Firm .....

Street..... City..... State.....

Circle 38A on reply card

Versatility at NATIONAL FORGE



Here is a ram, two flame-hardened rolls and a cylinder. In the left background is a crankshaft being machined.

This shows in a small part the large variety of forgings produced at National Forge. Small or large, alloy or carbon, heat-treated or annealed, rough or finished, each forged machine part is carefully produced to meet the customer's specification.

Besides a regular line of forgings, National Forge has additional facilities for contract machining and can produce single parts, sub-assemblies or complete machines.

This versatility offers you a service beyond the regular forge shop. Perhaps you have some problem in a forging or a machine component which might be solved at National Forge.

Write, wire, phone or visit us; we are always ready to be of service!

NF

National Forge
AND ORDNANCE COMPANY
Irvine, Warren County, Pennsylvania

STEEL MAKERS ☆ FORGESMITHS
HEAT TREATERS ☆ MACHINISTS

Circle 39A on reply card

Crucible Hollow Drill Rods being used in excavation for new Socony-Vacuum Bldg. Owner: Galbreath Co. General Contractor: Turner Construction Company.

they're using

CRUCIBLE HOLLOW DRILL RODS

on the Socony-Vacuum Building job

Across the street from New York City's Chrysler Building, the Slattery Contracting Company is busy moving a city block of earth and hard rock. They're preparing the way for construction of the new 42-story Socony-Vacuum office building.

It's another tough job on which thousands of tons of rock must be moved... and since Crucible Hollow Drill Rods are *first choice* for tough jobs, you'll find them being used extensively on this one. Construction men *know from experience* they can rely on Crucible Hollow Drill Rods for top performance.

That's because Crucible makes its hollow drill rods to *tool steel* standards. That means you'll have fewer broken rods, greater operating efficiency... *lower cost per foot of hole drilled*... when you specify Crucible Hollow Drill Rods.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **HOLLOW DRILL ROD**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • MAX-EL • ALLOY • SPECIAL PURPOSE STEELS

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

Circle 40A on reply card

WHEN PIPELINES CROSS WATER

explosives research pays off

The tremendous power of dynamite, skillfully and ingeniously handled, made it economically possible to cross the wide, deep Tennessee River (inset above) with two parallel pipelines, 50 feet apart. Trenches blasted underwater through hard red clay in the shallows, and lime rock in the 40-foot-deep channel, opened the way for speedy dredging operations . . . another example of the efficiency of modern explosives and blasting methods.

Hercules' research in the pioneering and development of explosives and our extensive service facilities are available to help you in solving blasting problems on construction jobs or in mining and quarrying operations.

Explosives Department

HERCULES POWDER COMPANY

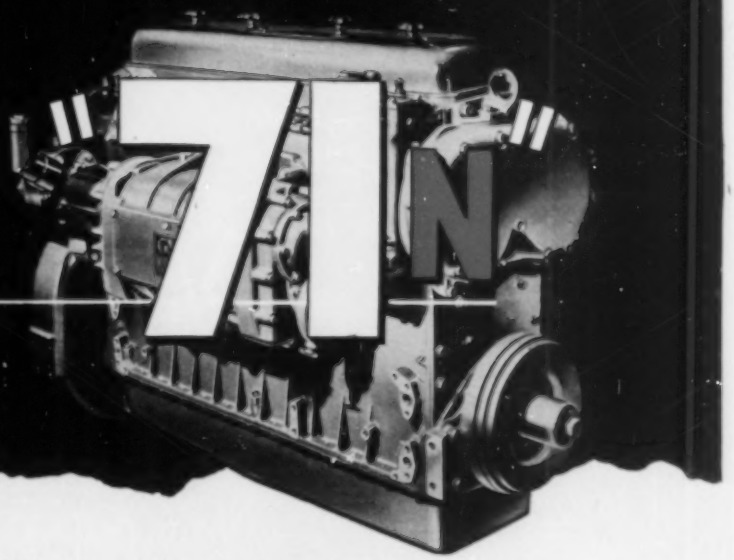
INCORPORATED

932 King St., Wilmington 99, Del.

Birmingham, Ala.; Chicago, Ill.; Duluth, Minn.; Hazleton, Pa.; Joplin, Mo.; Los Angeles, Cal.; New York, N. Y.; Pittsburgh, Pa.; Salt Lake City, Utah; San Francisco, Cal.

X854-6

WE SHOULD CALL IT the 71N



"N" FOR NEW—*New Where It Counts Most*

You don't have to be an old-timer to remember when the first General Motors Series 71 Diesel was introduced. We called it the "71" in 1938 and we call it the "71" today.

But in 17 years these design improvements from top to bottom have given operators higher horsepower, lower fuel consumption and longer engine life. And now, a whole series of new improvements has made this fast-stepping, compact, 2-cycle Diesel better than ever.

NEW **17 TO 1 COMPRESSION** gives better fuel economy, squeezing more power from every gallon of fuel.

NEW **"FIGURE 8" CYLINDER LINERS** give you a cleaner burning, more efficient engine. Air intake area is increased 32% for more complete fuel burning and better exhaust.

NEW **IMPROVEMENTS IN PISTON PIN, PIN RETAINER AND CAM FOLLOWER DESIGN** mean longer life, less maintenance cost. High-valve unit injectors last longer because the valve assembly is away from high cylinder temperature areas. Hard-chrome steel "Lite-Tite" piston rings resist wear; are tougher and more flexible and give many more hours of service.

And—best of all—in your next overhaul you can incorporate any or all of these new improvements in any GM Series 71 Diesel engine you're operating today. "The Inside Story" tells you how these new improvements can help cut your costs and speed your jobs. Mail the coupon today for your copy.

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS • DETROIT 28, MICHIGAN
Single Engines . . . 30 to 300 H.P. • Multiple Units . . . Up to 893 H.P.

It Pays to STANDARDIZE on GM DIESEL POWER

Write For Booklet

DETROIT DIESEL ENGINE DIVISION
General Motors Corporation
Detroit 28, Michigan

Please send me booklet "The Inside Story"

Name: _____
Position: _____
Company: _____
Address: _____
City & State: _____

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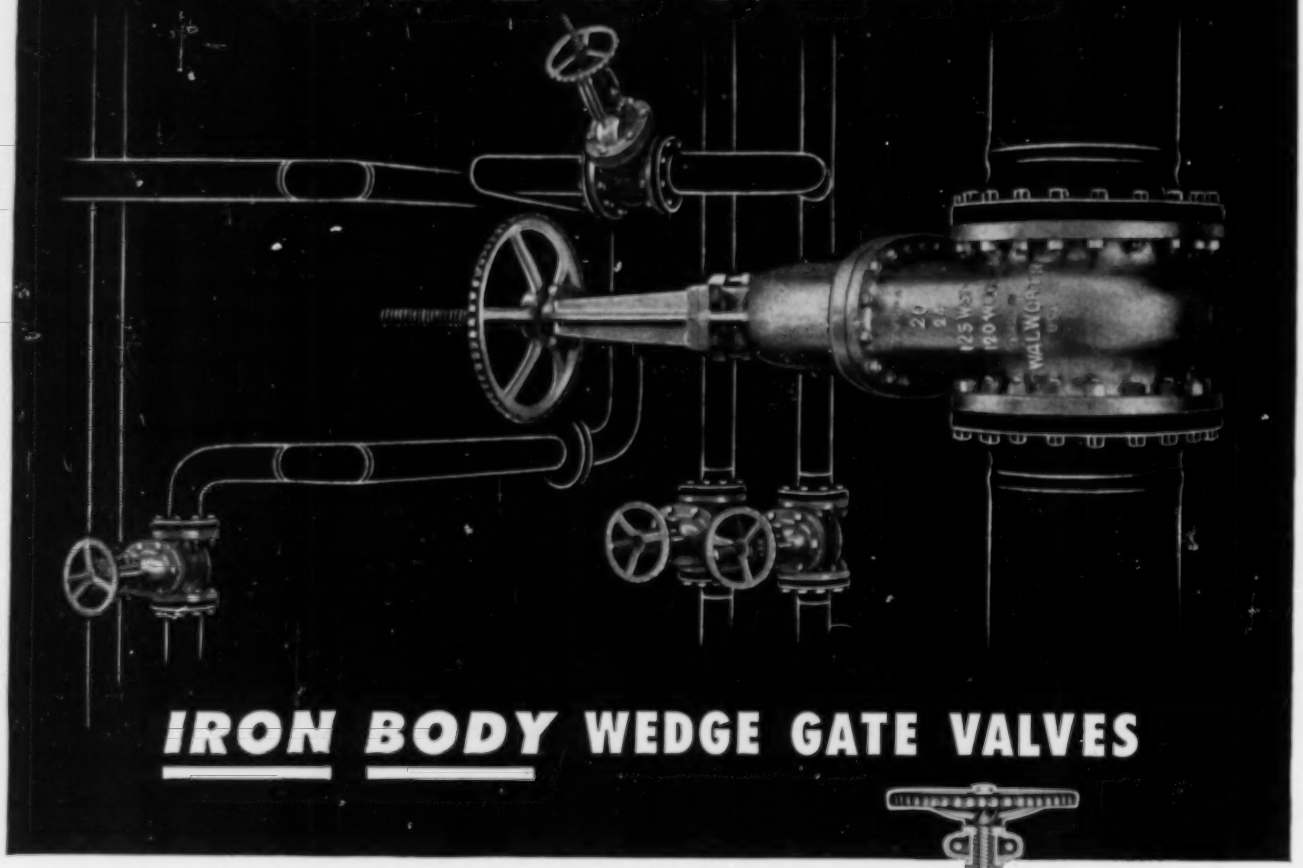
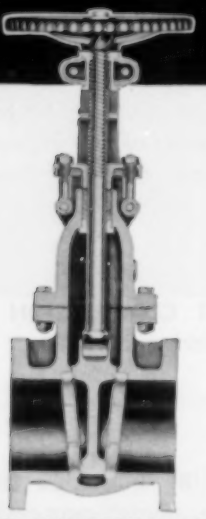
Circle 42A on reply card

WALWORTH



IRON BODY WEDGE GATE VALVES



Walworth No. 726F OS&Y (Outside Screw and Yoke) Iron Body Wedge Gate Valve. OS&Y valves are recommended for services where it is desirable that the line fluid does not come in contact with the stem threads. Note the swing-type gland-eye-bolts for easy repacking. Sizes 2 to 30 inches.

Better because ...**The entire valve, from handwheel to seat rings, is ruggedly constructed to withstand rough and frequent usage. Body, bonnet, and yoke are sturdy castings with large radius fillets. Dimensions and drilling of end flanges are in agreement with American Cast Iron Flange Standards. Stiffening ribs connect end flanges with the body neck to maintain a rigid connection with piping.**

A wide range of Walworth Iron Body Wedge Gate Valves is available—through your Walworth Distributor—from which you can choose the right type to meet your most exacting conditions. Saddle-type valves as small as ¼-inch; low pressure valves for water and gas pipelines up to 36 inches.

Whenever you need valves and fittings, choose from complete lines—in a variety of metals—manufactured by Walworth. For more information, see your Walworth Distributor or write: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

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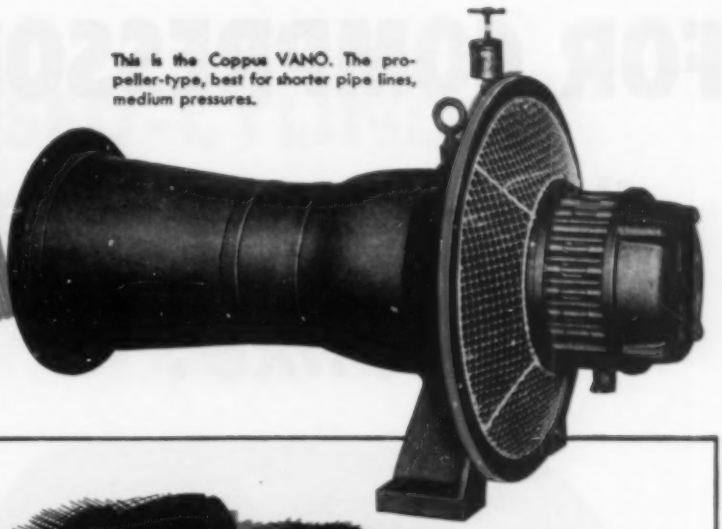
ANOTHER

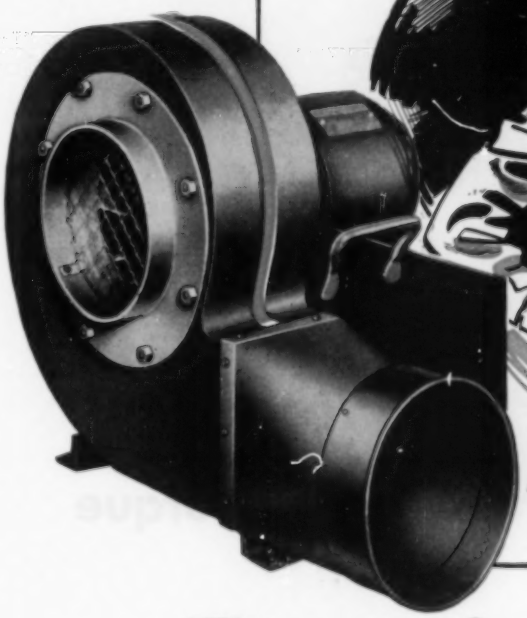
COPPUS

"BLUE RIBBON" PRODUCT



This is the Coppus VANO. The propeller-type, best for shorter pipe lines, medium pressures.

This is the Coppus VENTAIR. A centrifugal blower, it is designed for long pipe lines, high pressures.



These are the cost-reducing Blowers that give up to 100% more air

Only Coppus makes both types — and both are made especially for *mine* ventilation. One or the other, operating under the conditions for which it is designed, delivers from 30% to 100% more air for a given power consumption than an ordinary all-purpose fan.

They can be used as blowers or exhausters and are driven either by compressed air or electric motor, with capacities up to 90,000 CFM. Like all Coppus products, these blowers wear the "Blue Ribbon" that stands for high achievement in engineering, workmanship and performance.

for special purposes. See also THOMAS' REGISTER . . . Coppus Engineering Corp., Worcester 2, Mass.

COPPUS ENGINEERING CORPORATION
210 Park Avenue, Worcester 2, Mass.

Please send ..... Bulletin 130

Name .....

Company .....

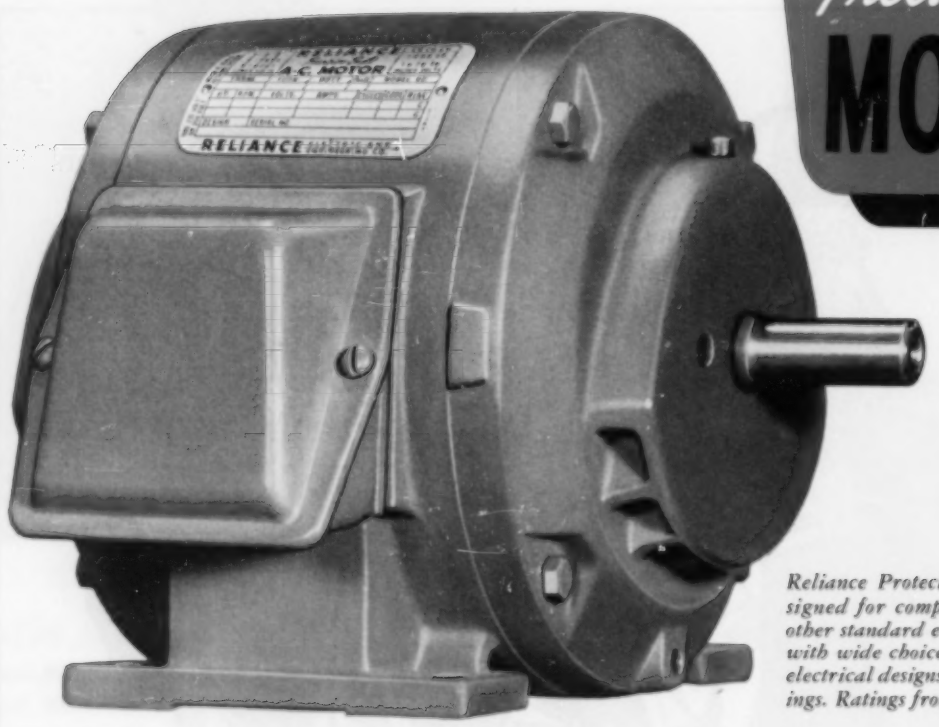
Address .....

Circle 44A on reply card

FOR COMPRESSOR SERVICE...

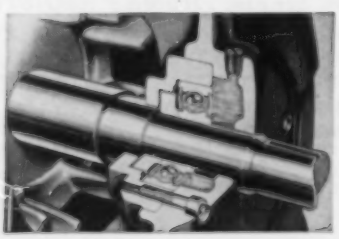
"All motors are NOT alike!"

RELIANCE *Precision-Built* **MOTORS**



Reliance Protected A-c. Motor designed for compressor service. All other standard enclosures available, with wide choice of mechanical and electrical designs and special mountings. Ratings from ¾ to 300 hp.

- ☆ Low starting currents... high starting torque ...liberal ratings
- ☆ Smooth acceleration . . . quiet operation
- ☆ Tough, vibration-proof Reli-X insulation



. . . AND THE BEST PRE-LUBRICATED BEARING DESIGN

The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And—whatever your lubrication schedule—*you just can't grease 'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. B-1458T

RELIANCE ELECTRIC AND ENGINEERING CO.

1118 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*

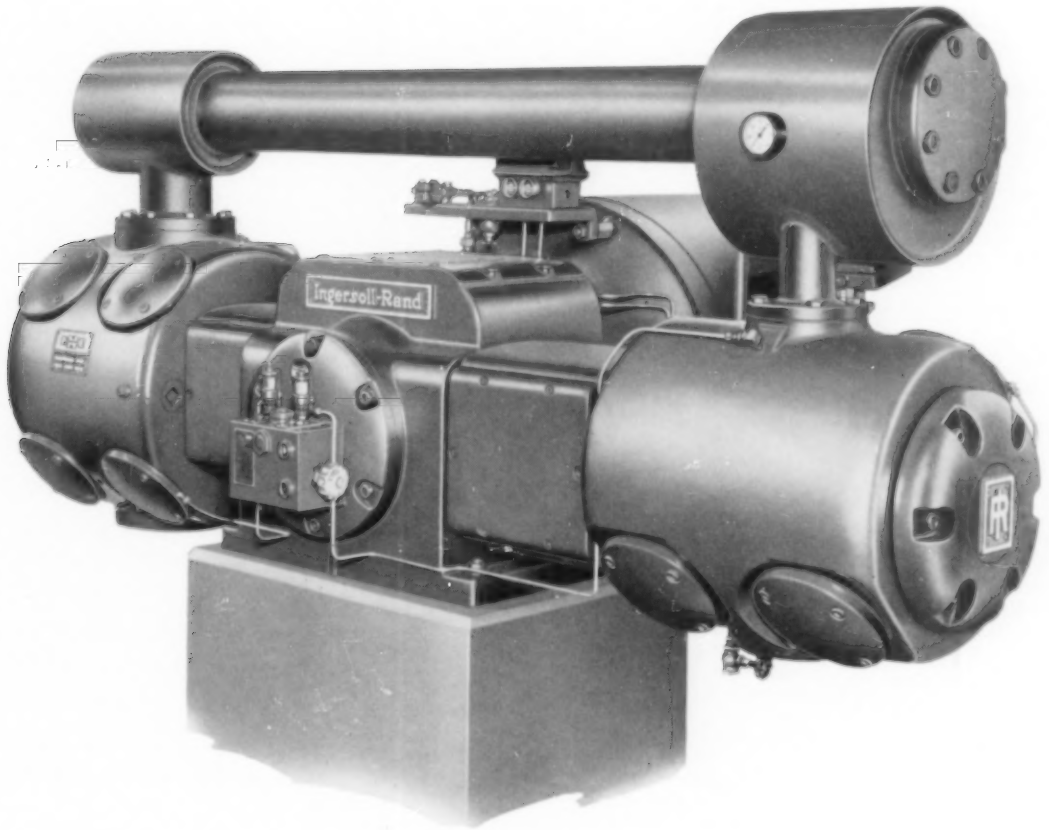
Circle 45A on reply card

NEW

OPPOSED-CYLINDER

BALANCED DESIGN, TYPE PHE

COMPRESSOR



COMPACT, SPACE-SAVING PACKAGED DESIGN

The new, space-saving PHE design marks another Ingersoll-Rand achievement in electric-driven compressors. Built for continuous, heavy-duty service, it includes the following outstanding features: Opposed pistons with excellent running balance – Efficient tube-type intercooler–New cylinders with Type A Channel Valves–Motor mounted directly on crankshaft–Full floating aluminum main and crank-pin bearings – Sealed crankcase – Force-feed lubrication.

FOR EASY SHIPMENT, INSTALLATION & RELOCATION

Shipped completely assembled and ready to run, the PHE compressor can be easily installed–in very little floor space–with a minimum of piping–and on a simple inexpensive foundation. Relocation, if required, is equally simple.

ELECTRIC-DRIVEN 75 AND 100 HP SIZES

The basic design is a two-stage unit for 80-125 psi. For other pressures, or for pumping vacuums, alternate cylinder arrangements can be supplied. It will pay you to get all the facts on this new, cost-saving design. Ask for Bulletin No. 3155.

Ingersoll-Rand

1-106 11 Broadway, New York 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

Circle 46A on reply card

TIMKEN® bearings help keep "Down East" glass production up

THIS is just one of six 75 hp Ingersoll-Rand low pressure air compressors at work in the plant of a large New England glass manufacturer. A breakdown here would be costly. One important way Ingersoll-Rand insures its compressors staying on the go: crankshafts are mounted on Timken® tapered roller bearings.

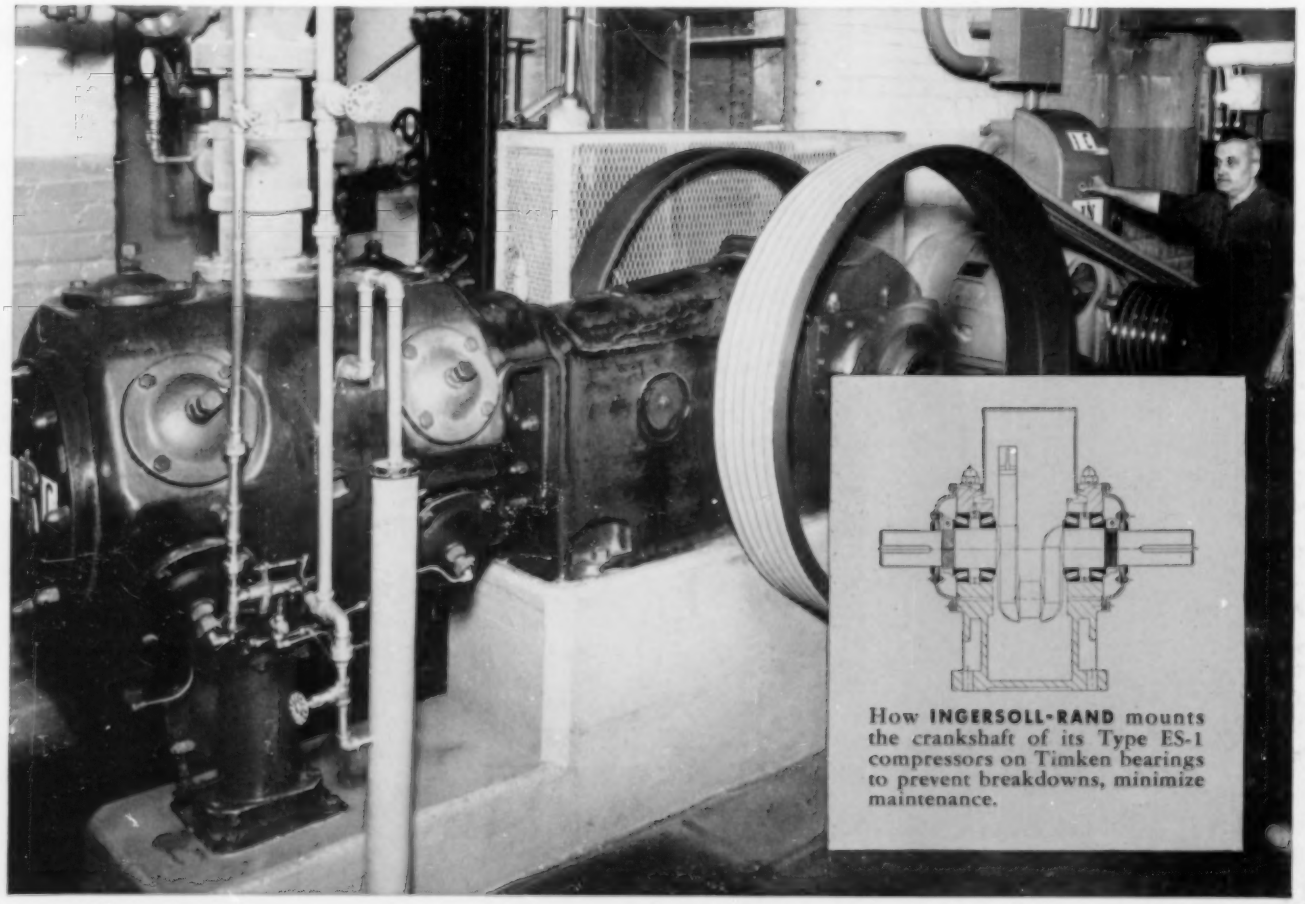
The tapered design of Timken bearings lets them take both radial and thrust loads, holds crankshaft in positive alignment. Wear on adjacent parts is reduced. Crankshaft wear is eliminated because there is no friction between it and the bearing. And friction within the Timken bearing is practically eliminated because: it is designed by geometrical law to have true rolling motion. Made with extreme accuracy to *deliver* the low friction this design makes possible. And made of steel we make ourselves. We're the only U. S. bearing maker who takes this extra quality precaution.

Timken bearings hold housings and shafts concentric, make closures more effective. Dirt and moisture stay out, lubricant stays in. Maintenance and lubrication costs stay down.

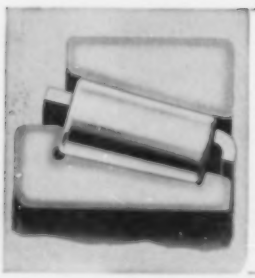
Specify Timken bearings for the machinery you build or buy. Look for the "Timken" trade-mark stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



How **INGERSOLL-RAND** mounts the crankshaft of its Type ES-1 compressors on Timken bearings to prevent breakdowns, minimize maintenance.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis Timken steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION →✳←

Circle 47A on reply card